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MCDC

STUDY

US INDUSTRIAL BASE DEPENDENCE/VULNERABILITY

PHASE I

SURVEY OF LITERATURE
DECEMBER 1986

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SPONSORED BY THE

MOBILIZATION CONCEPTS DEVELOPMENT CENTER

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Phase 2 in process 1/12/88

U.S. INDUSTRIAL BASE DEPENDENCE/VULNERABILITY SURVEY OF LITERATURE

This is a report on the first of a two-part study of foreign source dependence/vulnerability conducted by the Mobilization Concepts Development Center. This report summarizes the relevant studies on the subject.

The second part of the study, due to be completed in the Spring of 1987, develops a conceptual framework for analysis of foreign dependence/vulnerability, presents three case studies of foreign source dependence: precision guided munitions, semiconductors and industrial materials; and discusses policy options to address vulnerabilities.

William B. Taylor, Jr.
Director
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U.S. INDUSTRIAL BASE DEPENDENCE/VULNERABILITY

PHASE I - SURVEY OF LITERATURE

Roderick L. Vawter

Mobilization Concepts Development Center

National Defense University

December 1986

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Executive Summary

BACKGROUND

A serious potential problem that has become increasingly visible over the last several years is a growing dependency on foreign sources for a wide range of manufactured goods and materials used in U.S. defense production. A more recent phenomenon is the emergence of potential dependencies upon foreign sources for advanced technology for future weapon systems.

On 6 January 1986, the Under Secretary of Defense (Policy), in his role as Chairman, Mobilization and Deployment Steering Group (MDSG), noted an increasing number of studies and analyses in the area of foreign source dependencies and tasked the Mobilization Concepts Development Center (MCDC) to conduct a survey of all of the completed, ongoing and projected work in this area. This report provides the results of the survey and constitutes Phase I of an overall MCDC foreign dependency effort. Phase II, which will be completed in April 1987, will seek to identify and evaluate actions that could be taken to mitigate U.S. national defense vulnerabilities from a potential cutoff of foreign production sources in an emergency.

The scope of the Phase I survey covered both defense and civil industry studies. A total of thirteen defense studies are included in the survey, of which seven were internally initiated within DoD and six were directed by or performed for Congress. In addition to the defense studies, a larger body of work addresses the competitive status of U.S. industry in the international marketplace and, therefore, domestic industry's capability to support defense requirements. The preeminent document is Global Competition - The New Reality, prepared by the President's Commission on Industrial Competitiveness. Other work which addresses U.S. industrial competitiveness in the world marketplace includes studies by the National Research Council (6), Department of Commerce (14), and the International Trade Commission (12). See the bibliography at page 78 for all studies surveyed.

The studies reviewed here generally did not distinguish a foreign source from a foreign dependency from a vulnerability, the latter of which is the greatest cause for concern. Further, the studies reviewed here assumed a scenario in which all imports from all sources were cutoff, without an examination of the circumstances which might cause such an event. Phase II of the MCDC effort will make those distinctions. For the purpose of this paper, "a foreign source dependency" is any militarily useful material purchased outside the United States or Canada.

SUMMARY

Surge/Mobilization - Significant foreign dependencies exist in major weapon systems; cutoff would mean serious disruption of production.

Problem

The conclusion that emerges from the defense studies is that significant foreign dependencies exist in major weapon systems. The indication is that the problem is widespread and probably exists in most defense systems. The range of dependencies includes total systems such as chemical suits; major sub-systems such as heads-up displays and ejection seats; electronic assemblies; and electronic components including semiconductors and ceramic packages. Other dependencies noted in the studies include optics, chemicals, and raw materials ranging from electronic feed materials to strategic and critical materials.

Three basic industries were addressed in reports requested by Congress. A report to the House Appropriations Committee on the semiconductor industry said fundamental concerns are raised by a structural manufacturing dependence upon foreign sources for materials, parts and production equipment. A report on the U.S. bearing industry found it to be in imminent danger of being unable to support national defense needs. Regarding the U.S. ferroalloy industry, a report concluded that, if U.S. capacity were lost, mobilization requirements could be met only if U.S. demand had absolute priority on worldwide capacity and there were no disruptions or noncooperation.

In general, NATO and the European countries tend to be the sources of foreign dependency for complete systems or major subsystems, as well as for built-up components and chemical products. Japan and the Far East are the principal sources of semiconductors and semiconductor assembly essential to U.S. systems containing electronics.

Impact

For the Sparrow, M-1 tank, OH-58D helicopter, sonobuoys, F/A-18 and F-16, the impact of a total cutoff from foreign sources would be a drop to zero production for periods ranging from 6 to 14 months, starting as early as the second month after M Day. This was the finding of A Study of the Effect of Foreign Dependency prepared for the Joint Logistics Commanders.

Technology - growing foreign dependency exists in the electronic technology base critical to advanced weapon systems.

Competitive forces in the world-wide semiconductor industry

threaten U.S. technological leadership. The fundamental technological concern is the long-term health of the independent or "merchant" portion of the U.S. semiconductor industry. A healthy merchant semiconductor industry is said to be essential because militarily useful semiconductor technology is increasingly being driven by commercial applications. The other portion of the U.S. semiconductor industry, the "captive" producers such as IBM and AT&T, notwithstanding their broad technological capability and current good health, cannot be expected to carry the entire load of maintaining U.S. technological leadership across the entire spectrum of militarily essential electronics technology.

The merchant's share of the domestic market has dropped from 58 percent in 1984 to 50 percent in 1985 and a projected 48 percent in 1986. The effect will be a growing inability to fund R&D and make capital investment at levels high enough to remain competitive. Therefore, within the next decade, the possibility exists that the U.S. may become dependent upon foreign sources for semiconductors. Semiconductors are the key building block for electronics which increasingly provide the qualitatively superior weapons needed to overcome the quantitative superiority of the Soviet Union.

The U.S. semiconductor equipment industry, which provides the machine tools of the electronics industry, is in a similar condition. Semiconductor technology of the future will involve small integrated circuits, more complex device architecture and innovative uses of new materials. According to a recent 1986 report published by the National Research Council, the future of electronic materials and devices critical to advanced defense systems depends entirely upon the development of advanced processing technologies. The report says the Japanese are currently ahead in 8 of 11 key areas of advanced processing technology.

The Defense Science Board and the National Security Council have been examining the U.S. semiconductor industry in terms of its impact upon national security, principally from the standpoint of technology.

Foreign dependency is not being addressed in any systematic or effective way, either by correction or accommodation.

Although the very existence of the studies represent attention to the issue of foreign dependence as a potential first step to action, a persistent theme that emerges from the studies surveyed is that foreign dependencies in weapon systems have not been dealt with in any systematic or effective way by DoD. Little action beyond the studies has been taken to identify the existence of foreign dependencies in specific weapon systems and to pursue effective corrective actions which would result in the creative of alternative domestic sources. On the other hand, no

broad-based action has been taken to assure that the U.S. can live with foreign dependencies in a national security emergency. At the present time, other than the long-standing industrial mobilization agreement with Canada, the U.S. has no cooperative industrial mobilization agreements with its friends and allies which would assure the continued supply of essential manufactured goods in the event of a crisis. In effect, the assumption that foreign sources will be available in a crisis is just that - an assumption.

An indication of the lack of a systematic treatment of foreign dependency is the conclusion reached by several studies that no data base or information management exists that contains good information on the incidence and extent of foreign dependence in specific weapon systems. Foreign dependencies were hard to find and much of the available information was misleading, obscure and hard to assess.

The imbedded nature of many of the dependencies, evidenced in the difficulty in identifying specific items within weapon systems, is a reflection of the dependencies that exist in the overall U.S. economy. At the sub-tier level, defense foreign dependencies are a microcosm of economic interdependence that has evolved over the years. The economic causes of dependencies include lower cost, higher quality, and the distortions resulting from an overvalued dollar.

Beyond economic causes, the studies point to a second major cause of foreign dependencies, the policy conflict that exists between three conflicting DoD goals. The three goals are NATO rationalization, standardization and interoperability (RSI), protection of the U.S. mobilization base, and competition. RSI will facilitate resupply in a conflict and, among other things, calls for greater industrial cooperation with NATO as a means of strengthening the military capability of the alliance. Foreign participation is encouraged in sub-contracting to U.S. primes, in teaming and licensing arrangements, and in early industrial participation in R&D projects. NATO country contractors are also afforded the opportunity to compete for DoD procurements. The intent of increased cooperation is to strengthen the "NATO Industrial Base." The second goal, the "U.S. Mobilization Base", dates back to 1952 and calls for the maintenance of a sustained state of national mobilization production readiness. Specifically, the facilities, machine tools, production equipment, and skilled workers necessary to produce wartime requirements are to be maintained for immediate use in an emergency. The third policy goal, competition, is founded in the Competition In Contracting Act. According to several studies, the priority given to competition is often not balanced by consideration of mobilization base issues. Competition goals could lead to awards to non-NATO foreign firms, thereby supporting neither RSI or the U.S. mobilization base.

The practical effect of the policy conflict is that the program manager has no clear guidance on how to resolve the several priorities. As a result, procurement policies and practices do not adequately address foreign dependency. As an extension of this point, A Study of the Effect of Foreign Dependencies prepared for the Joint Logistics Commanders, observes that DoD is not managing foreign dependencies during system development and procurement. In addition, no effective organizational responsibility exists within DoD for addressing foreign dependency, according to the studies. However, in July 1986 and not addressed in the literature reviewed in this survey, the Army Materiel Command took action to create a Production Base Advocate whose task it will be to inject industrial base surge and mobilization issues into the Army's acquisition process.

Therefore, consistent with the above, it was noted that a lack of action by DoD to emphasize and deal with the issue will result in increasing foreign dependency in future weapon systems.

The defense industrial base is founded on the civilian industrial and technological base. The U.S. is losing both smokestack and high technology industrial capability. Currently healthy industries essential to national defense have the potential of losing competitiveness.

A healthy civilian industrial base is critical to the capability of the defense industrial base. That fact is rooted in the production relationship that exists between the two. Military and civilian demand are met by the same general industries which draw from the same basic production input factors such as capital, technology, scientific and skilled manpower, and management. Therefore, weapons production rests on the same foundations as the national ability to produce industrial and consumer goods. Weaknesses and gaps which exist in subtier and basic industries will inevitably affect the national ability to produce weapon systems critical to national defense. Figure ES-1 below visually depicts this relationship.

Many studies are available which address the health and international competitiveness of U.S. industry, few of them in a favorable light. The preeminent document is the report of President's Commission on Industrial Competitiveness, Global Competition - The New Reality. The report makes the point that the economic environment that U.S. industry operates in has changed dramatically since the 1950's. The U.S. economy has been overshadowed by the growing international economy which is becoming increasingly interdependent. Almost 20 percent of U.S. production is exported and over 20 percent of U.S. goods must compete with foreign products in the domestic market. There has been a shift away from Europe as the major trading partner. The new competitors for U.S. industry are Japan and the newly indus-

trialized countries of the Pacific Rim - Taiwan, South Korea, Singapore, Hong Kong and Malaysia. These countries have taken advantage of the mobility of technology and have aggressively applied it to the manufacture of high quality, low price consumer goods.

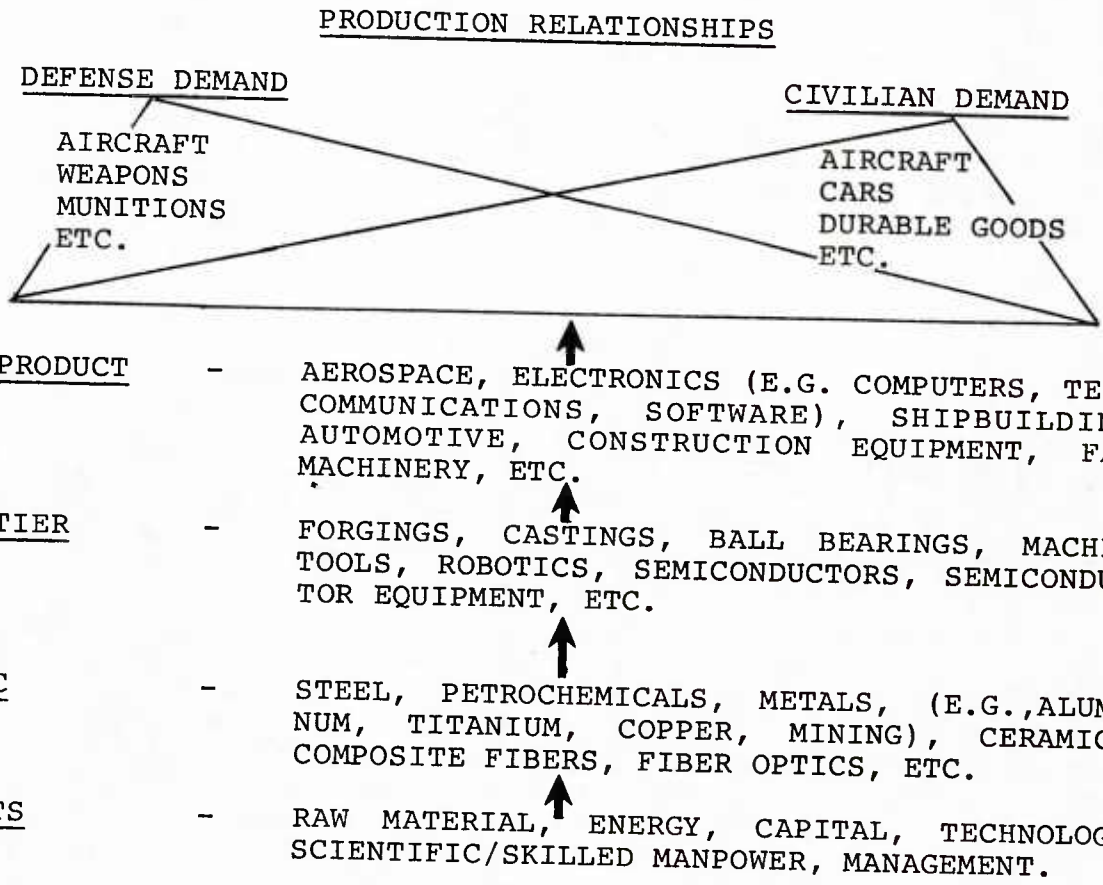


Figure ES-1

At the same time that major new and highly productive competitors have emerged, the U.S. has experienced a stagnated productivity growth rate. From 1960 to 1983, the U.S. has had an average annual productivity growth rate of only 1.2 percent, lower than all of our major trading partners. In contrast, Japan had 5.9 percent annual growth, Korea had 5.3 percent and West Germany 3.4 percent.

Productivity has been one factor in a growing problem of negative trade balances. The U.S. has had a negative trade balance since 1975, as contrasted to a positive trade balance for the entire 20th century prior to 1971. As of July, the U.S. was on a track towards a negative balance of $170 billion for 1986.

The U.S. has lost world market share in both smokestack and high technology industry. Global Competition notes that, since 1965, 7 of 10 high technology industries have lost market share. The effect of the decline is diminished production and technological capability in industries critical to national security. Table ES-1 summarizes the status of several of the civilian industries examined in the report. Each of these industries is important to national defense, either as direct producers of military goods or as convertible capacity in a mobilization. The several measurements are those considered important from a military viewpoint; the ideal situation would be up arrows for all except interdependence, where one would like to see a dash for no factor. This sample reflects the disturbing circumstance of declining competitiveness for many industries which would be critical to national defense in a broad mobilization.

In contrast to our trading partners, most of whom set trade and industrial competitiveness as national policy, the U.S. has no coherent national policy pushing trade. Given the international environment in which the U.S. must now compete and the fact a positive trade policy would be the starting point for many other policies, this is an important cause of U.S. industry competitive decline. Examples of policies that are inadequate to the new reality of global competition are trade and antitrust laws, which are obsolete in form and effectiveness.

Besides trade policy, fundamental problems exist in the areas of technology, capital, human resources and, until very recently, the exchange rate of the dollar. Notwithstanding large national R&D expenditures, the U.S. lags in developing and applying technology to new products, particularly in relation to Japan. Government funded R&D has no competitiveness goal and no common management. Few incentives exist for privately funded R&D in basic research, which is the fist step in developing new technology. The U.S. trains fewer engineers than Japan and 55 percent of U.S. engineering doctorates awarded in 1984 went to foreign citizens. This has implications for our ability to train more engineers in the future.

The supply of capital to U.S. industry is inadequate, according to the President's Commission. The first cause of this is low U.S. savings rate, which is much lower than that of our foreign competitors, particularly Japan which saves at a rate of about 18 percent vs. a U.S. savings rate of about 7 percent. The second cause is the U.S. budget deficit. Since the Government has first call on capital, it bids it away from private industry. The influx of foreign capital has mitigated this circumstance, but cannot be counted upon indefinitely.

STATUS OF SELECTED INDUSTRIES

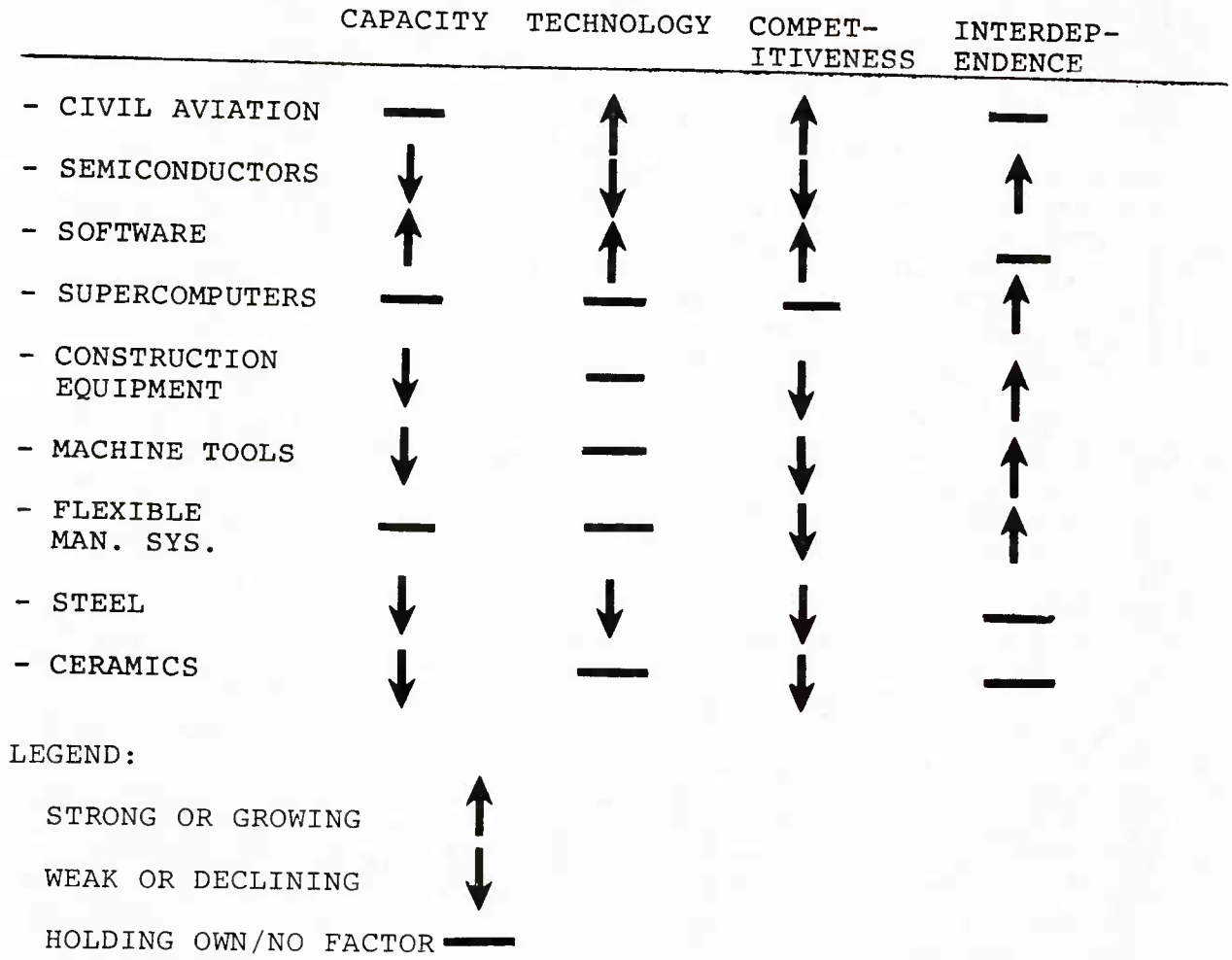


Table ES-1

The quality of the U.S. human resource base is deteriorating for a variety of reasons. One cause is the historic adversarial relationship between management and labor which may no longer serve the interests of the parties involved or the nation as a whole. Another is the lack of adequate programs to develop new skills in displaced workers, who should be redeployed to new jobs deriving from new technology and markets. Part of the redeployment issue is the need for forward-looking training, from employers and from the educational system. The President's Commission notes that employers have few incentives to train their workforce beyond the requirements of the current job. It also endorsed the call for improvement in elementary and secondary education made by other bodies.

U.S. industry is reacting to the various circumstances just described by focusing on survival, regardless of what it takes. Business Week has coined the phrase "Hollow Corporation." To survive, U.S. companies are outsourcing parts and materials, outsourcing labor to perform the assembly operation and outsourcing product lines. In the latter case, such as small cars, machine tools and construction equipment, U.S. companies have withdrawn from the manufacture of certain types of products and have maintained market segment by putting their label on foreign produced goods. The effect of this is to lower demand for other U.S. industries such as steel, forgings, castings and a host of other basic industries.

Another strategy being pursued by industry is an increasing movement to joint R&D and manufacturing ventures with foreign firms. This has the potential effect of creating more interdependence, more foreign competition, and less domestic capability, particularly in the basic industries.

CONCLUSIONS

Like the U.S. economy as a whole, the U.S. defense industries directly or indirectly purchase some portion of their goods from abroad. Left unaddressed, this could affect national security. If there are risks posed to national security by foreign dependency, DoD needs to pursue two basic courses of action.

First, as regards its own plans and programs, DoD needs to manage foreign dependency in a focused, effective way. It needs to resolve the conflict that currently exists by balancing the policy goals of RSI, maintenance of the mobilization base, and competition. A policy should be set which requires that foreign dependency be managed during system development, as well as in early research and development for future systems. DoD needs to set responsibilities within the organizational structure, to assure that the problem is dealt with on an equal footing with other acquisition issues. Once policy and responsibilities are set, comprehensive programs to enforce compliance must be put in place.

Second, beyond DoD's specific responsibilities in acquiring and fielding weapons, DoD should take an active leadership role within the Federal Government to assure that the national security implications of the deteriorating U.S. industrial and technological base are addressed in national policies and programs.

FOLLOW-ON EFFORT

This report documents Phase I of a two-phased effort. Phase II will be completed in April 1987 and will address several issues implicitly raised in the Phase I effort. First, Phase II will define the circumstances in which the dependencies identified in Phase I represent vulnerabilities which must be eliminated. Second, through the medium of case studies, the costs and benefits of alternative generic means of eliminating vulnerabilities will be developed.

I. INTRODUCTION

The purpose of this paper is to report the results of a survey of literature dealing with foreign dependency.

A serious issue that has become increasingly visible over the last several years is that of a growing number of foreign sources for a wide range of manufactured goods and materials used in U.S. defense production. A more recent phenomenon is the emergence of potential dependencies upon foreign sources for advanced technology for future weapon systems.

Many studies have touched upon foreign dependency, to include the Industrial Responsiveness Analysis (IRA), designed by the Mobilization Concepts Development Center (MCDC). The identification of foreign dependency as the most serious emergency production constraint in the IRA led MCDC to decide to undertake a study of foreign dependency, with the goal of identifying actions required to achieve a condition of no exploitable vulnerability in the ability of the U.S. to muster resources for national defense.

On 6 January 1986, the Under Secretary of Defense (Policy), in his role as Chairman, Mobilization and Deployment Steering Group (MDSG), noted that there were an increasing number of studies and analyses in the area of foreign source dependencies and tasked MCDC to conduct a survey of all of the completed, ongoing and projected work in this area.

The results of the comprehensive survey were briefed to the MDSG on 7 April 1986. This report documents that briefing.

The MDSG was also briefed on the proposed scope of work for a follow-on study to be completed by April 1987. The scope of this follow-on effort calls for the definition of the circumstances in which foreign dependencies discussed in this report represent exploitable vulnerabilities that must be eliminated, and for the determination of the costs and benefits of alternate generic means of eliminating such vulnerabilities.

Scope of the Survey

As noted by Dr. Ikle in his tasking of this effort to MCDC, there is a large body of work on the general subject of foreign source dependencies. The various studies and reports fall into two general categories. First, there are a number of studies which address the implications of foreign dependency upon national defense, either in a targeted way or as a secondary message. Second, there are many studies which address the competitive status of U.S. industry in the international marketplace and, implicitly, domestic industry's capability to support defense requirements.

The defense studies can be further differentiated by initiator, the Executive Branch or Congress. Six studies initiated by the Executive Branch had been completed, or existed in a solid draft, as of the briefing to the MDSG and are included in this report. Major studies were in process by the Defense Science Board and the National Security Council on the semiconductor industry with reports not available at this time. Subsequent to the MDSG briefing, a study on Gas Turbine Engines was completed and is included in this report.

As an indication of the growing awareness of a "defense problem" with foreign dependency, a number of studies has been directed by or performed for Congress. Specifically, three studies had been completed (or drafted) and five other studies had been directed and were underway as of the MDSG briefing. Several of the in process efforts were subsequently completed and are also included in this report.

The second general category of studies, those dealing with civilian industry, addresses a very broad range of industrial activity which has an effect, directly or indirectly, upon the defense industrial base and the nation's ability to produce weapons in peace and war. The preeminent document is Global Competition-The New Reality, prepared by the President's Commission on Industrial Competitiveness. That report, published in January 1985, provides a framework for making sense of the many studies addressing U.S. industrial competitiveness. Studies reviewed included six by the National Research Council (NRC), fourteen competitive assessments of specific U.S. industries prepared by the Department of Commerce (DoC) and twelve International Trade Commission (ITC) studies dealing with the international competitiveness of U.S. industry. These studies do not represent the universe as a number of DoC and ITC industrial studies were not included in the survey because they were judged to be too peripheral to the issue of defense.

Also reviewed were several classified studied to include a National Security Council Study of the critical and strategic materials stockpile and several Central Intelligence Agency reports dealing with various aspects of foreign dependence. This material is not addressed in this report. It is believed that their inclusion would not have a material effect on the insights provided by the survey. On the other hand, an unclassified report encourages a broader readership of this survey of the foreign dependency issue.

A conscious decision was taken to not make a general survey of strategic and critical materials, for several reasons. In contrast to the recent phenomenon of foreign dependence in manufactured goods and technology, materials foreign dependence has been an acknowledged fact of life since World War II. The issue has been documented in great depth; a 1983 National Defense

University Library bibliography on strategic and critical materials contains 42 pages of citations. Performance of a survey of the most recent literature would have added substantially to the task and would have been somewhat peripheral to the manufacturing foreign dependency issues which prompted the MDSG tasking.

Over and above the specific studies discussed above and addressed in the following, a great many books and articles were reviewed. This material provided background and building block knowledge for the broad issue of U.S. industrial competitiveness. The most relevant readings are identified in the bibliography.

In general, the survey was limited to the most current studies available. For example, several defense studies dating to 1983, which were the first of a continuum, were not included because it was assumed that the latest effort would identify most of the foreign dependency issues. For this reason, the most notable exclusions were the Industrial Responsiveness Simulation and the Air Force Blueprint for Tomorrow. On the other hand, civilian industry reports dating to 1983 were included when they repre- sented the principal evidence for a particular industry. The vast majority of the material, however, dates from 1984 or later.

II. DEFENSE STUDIES

A. Background

The preceding discussion of the scope pointed out that the existing foreign dependency literature falls into two general categories, defense studies and civilian industry studies. Within defense, the preponderance of the work focuses upon foreign dependency in terms of its impact upon the Nation's ability to expand production in a crisis. It has been this issue, emergency production capability, that has brought foreign dependency to the forefront over the last several years.

A second and potentially more serious threat, however, is now emerging: foreign technology dependency. Technology is a principal focus and concern of the on-going Defense Science Board and National Security Council semiconductor studies addressing the national security implications of import penetration. Many believe that technological dependencies may, in the long term, be more significant than current production dependencies for specific items. This report will address these two issues separately.

The surge/mobilization studies, in general, address the existence of foreign dependency and the implications of a worst case situation, that is, a complete cutoff from all foreign sources of supply. The studies tend not to deal with the subtleties of dependence as distinct from vulnerability. Clearly, not all dependencies are vulnerabilities. Some may be readily corrected in a crisis with minimal time and cost penalties. Others may not lend themselves to a cost-effective fix. Others may be so significant, and the risks so great, that corrective action is required almost regardless of cost.

This report will attempt to summarize, in a coherent, logical way, what the various reports have to say about foreign dependency. It will not attempt to reconcile definitions of foreign dependency or to draw a distinction between dependency and vulnerability. For purposes of this report any foreign purchase is a foreign dependency. Distinctions between a foreign purchase and a vulnerability stemming from a foreign purchase will be addressed in follow-on work by the Mobilization Concepts Development Center in Phase II.

B. Implications for Production in Surge and Mobilization

Extent of Foreign Dependence

Significant foreign dependencies exist in major weapons systems. The phenomenon is widespread and probably exists in most defense systems. This conclusion is the consensus of a number of studies which, directly or indirectly, addressed the question of foreign source dependencies as they relate to national defense and the production of military hardware. The dependencies spread across a wide range of production inputs. They include a few instances of total systems purchased offshore, such as chemical protective suits purchased from England. They progress down the production chain to include major sub-systems such as heads-up displays, electronic assemblies and electronic components to include semiconductors and ceramic packaging. Other dependencies noted in the various studies include optics, chemicals, and raw materials ranging from electronic feed materials to the long-standing problem of strategic and critical materials.

One of the most pervasive of foreign dependencies is that of electronic components, particularly semiconductors. An emerging problem is foreign sole sourcing for some types of advanced electronic items, which has implications for long-term technological leadership and crisis production. A different problem, one that has existed for many years, is the offshore dependency created by the manufacturing practice of the U.S. merchant semiconductor industry. U.S. firms performed the high technology

"front end" manufacture of the basic device on silicon wafers in the U.S. and, for cost reasons, had the more labor intensive "back end" removal of chips from the wafer and the assembly, packaging and testing of individual integrated circuits performed at offshore sites, typically in the Far East. As the availability of automated processes has reduced the labor cost factor, the assembly operations have remained offshore because of the emergence of well trained and effective technical infrastructures in places like Malaysia, Singapore, and Thailand. Certain military specification items must be produced in the United States, produced on certified foreign lines, or at least be available from a qualified U.S. production line maintained and demonstrated every 3 years. Nonetheless, most items used by the military have some foreign component. The Air Force 1985 Production Base Analysis (PBA) points out that 90 percent of the military semiconductors are assembled offshore.

A report requested by the House Appropriations Committee (HAC) identified an increasing reliance by U.S. industry upon foreign sources for materials, parts, and equipment used in manufacturing semiconductors, items such as ceramic packages, gold leads, photomask blanks, and production equipment. The HAC was told that this structural manufacturing dependence, coupled with loss of market share for finished products and the offshore assembly described above, raises fundamental concerns about DOD reliance on foreign sources.

Other reports requested by Congress, which were not available until after the briefing to the MDSG, provide the status of two basic foundation industries. For the case of bearings, a report found that the U.S. bearing industry is in imminent danger of being unable to support national defense needs. The industry has suffered a steady erosion of its commercial market share since 1978, due to its inability to compete with foreign competitors. As a result the U.S. bearings industry has lost capacity and capability.

Another report to Congress on the ferroalloy industry addresses the effects on national defense of a total loss of U.S. production capacity. Import penetration stands at 90 percent for ferrochromium and 80 percent for ferromanganese, two of the three principal ferroalloys. The U.S. industry maintains 80 percent of the market share for ferrosilicon. If all U.S. capacity were lost (the report states that U.S. capacity may have stabilized), the U.S. mobilization demand could be satisfied by worldwide capacity only if it has absolute priority on the world market and providing a number of other highly advantageous assumptions are made. If U.S. capacity is lost and there is disruption of supplies from South Africa and Europe, U.S. mobilization demands could not be met.

It is useful to make some generalized conclusions as to the

sources of foreign dependencies for U.S. weapon systems, the causes of which will be discussed later. NATO and the European countries tend to be the source of supply in those instances of U.S. purchases of complete systems or major subsystems, as well as built-up components and chemical products. Japan and the Far East are the principal source of semiconductors and semiconductor assembly. Semiconductors are the key building block for U.S. systems containing electronics.

As noted earlier, the various studies do not deal with the distinction between dependence and vulnerability, particularly the circumstances which would make the U.S. vulnerable. Several studies identify the effect on defense production of a total cutoff from foreign sources. The most definitive work in this regard is A Study of the Effect of Foreign Dependency prepared for the Joint Logistics Commanders (JLC). The JLC study identified foreign dependencies in 8 of 13 systems investigated. After detailed study into each system's subtier structure, the impact of a complete cutoff from foreign sources was identified as a drop to zero production for the items effected for periods ranging from 6 to 14 months, starting as early as the second month after M Day. Items so effected were Sparrow, M-1 tank, OH-58D, sonobuoys, F/A-18 and F-16. Two other studies implied a similar impact, without the detailed schedule assessment made by the JLC study. The Industrial Responsiveness Analysis (IRA) concluded that no expansion of electronic end items could be achieved without prior preparedness actions having been taken by domestic industry. The Air Force PBA states the impact a little differently in that no expansion of electronic end items could be achieved without the cooperation of allies.

Beyond the existence and impact of foreign dependencies, several other problems were identified. Several studies noted the basic lack of data on the existence of foreign dependencies in specific weapon systems. No data base or information management system exists which keeps track of foreign dependencies. Researchers attempting to document the issue have discovered that imbedded foreign dependencies are hard to find and that the information that is available tends to be misleading and hard to use. As a subset of the information problem, an Industrial College of the Armed Forces (ICAF) study done for OSD to respond to a Congressional request to assess the effect of proposed domestic content legislation on DOD procurement concluded that no data exists on the effects of trade upon the U.S. industrial base.

Finally, the studies covered by this survey noted that there is little or no evidence of attention or corrective action by the Department of Defense. The existence of the studies, however, represents evidence of attention to the subject as a preliminary step to action.

A summary of the problems and the study sources is provided in Table 1.

Table 1

Implications For Production in a Crisis

	Source(s)
General	
1. Significant foreign dependencies exist in major weapon systems, are widespread, probably exist in most systems.	JLC, IRA, PGM, PBA, IDA, GTE, NRC
2. General sources of dependency:	
a. NATO/Europe - systems, subsystems/components/chemicals.	JLC, IRA, PGM
b. Japan/Far East - Semiconductors.	JLC, IRA, PGM, ICAF
3. Impact of cutoff:	
a. Zero production for 6-14 months, starting as early as M plus 2.	JLC
b. No expansion of electronic end items without domestic prior preparedness.	JLC, IRA
c. No expansion of electronic end items without the cooperation of Allies.	PBA
4. No data base or information management system exists.	JLC, NRC, GAO
a. Foreign dependencies are hard to find; available information is misleading, obscure, hard to assess.	JLC, IRA, NRC, OSD
b. No data on the effects of trade on the U.S. Industrial Base.	ICAF
5. Little or no evidence of attention or corrective action by DoD.	NRC, ICAF
Industry Specific	
Microelectronics - Loss of domestic market share and transfer offshore to U.S. assembly and test is causing fundamental concerns of growing reliance, if not dependence, on foreign sources.	OSD

TABLE 1--Continued

Ferroalloys - If U.S. ferroalloy capacity is lost, mobilization requirements can be met form worldwide sources only if U.S. demand has absolute priority and no disruptions or non-cooperation occur.	LMI
Bearings - U.S. domestic industry is in imminent danger of being unable to support national defense needs.	JBWG

LEGEND

GAO - GAO, Assessing Production Capabilities and Constraints in the Defense Industrial Base, 1985
GTE - AF, Gas Turbine Engine Study, Phase I Interim Report, 1986
ICAF - OSD, The Potential Effect of Domestic Content Legislation on DoD Procurement, 1986
IDA - OSD, Technical Assessment of U.S. Electronics Industry, 1985
IRA - OSD, Industrial Responsiveness Analysis, 1985
JBWG - JLC, Joint Logistics Commanders Bearing Study, 1986
JLC - Joint Logistics Commanders, Study of Effect of Foreign Dependencies, 1986
LMI - OSD, The Effects of a Loss of Domestic Ferroalloy Capacity, 1986
NRC - Army, Production of Electronic Components and Army Systems Vulnerabilities, 1986
OMB - OMB, Impact of Offsets in Defense Related Efforts, 1986
OSD - OSD, Report to the HAC, Defense Use of Foreign Sources of Electronic Microchips, 1986
PBA - AF, 1985 Production Base Analysis, 1985
PGM - JCS, Precision Guided Munitions, Phase I & II, 1985

Causes of Foreign Dependence

The basic causes of foreign dependencies in U.S. weapons systems fall into two basic categories, economic and DOD policies and programs. DoD has little control over the economic causes; it must take direct responsibility for its policies.

Economic

Perhaps the least tractable of the causes, from a U.S. Government standpoint, is the decline in the overall health and international competitiveness of specific industries critical to defense production. Defense dependencies, particularly for imports from industries not driven by defense procurement, are a microcosm of dependencies in the broader U.S. economy. This point is made most directly in the ferroalloy and bearing studies prepared to respond to Congressional inquiries. These studies discuss the conditions of industries which have, due to international economic conditions, lost capacity and capability which would be required to support expanded defense needs in an emergency. The overall issue of civilian industry, and the circumstances of its competitive decline and its impact upon national security, will be discussed in a later section of this report.

The manufacturing practices of some industries are causing foreign dependencies. The most notable has already been discussed, i.e., the long-standing practice of the U.S. merchant semiconductor industry to perform the back end assembly and test of semiconductors offshore, principally in the Far East and even with the advent of automation. It should be noted that the Japanese semiconductor industry chose not to create a similar dependency. Early on, decisions were made to retain the full production process within Japan by developing and investing in assembly and testing automation.

There are instances of foreign sole sources, which have arisen for a variety of reasons. One type of sole sourcing is caused by the termination of U.S. production due to environmental restrictions, e.g., a chemical used in rocket motors is carcinogenic and is no longer made in this country. Sole sourcing is caused in some instances by foreign patented processes which have not been licensed to U.S. producers e.g., polyimide resin used in glass polyimide printed wiring boards, which comes from France. A common sole sourcing problem is various critical and strategic materials for which there is no U.S. source, often due to the fact that U.S. deposits are not economically viable.

Other causes of foreign dependency which fit under the general category of economic include cost, quality, and superior technology. The JLC report attempted to deal with the causes of foreign dependency in a comprehensive way. Regarding cost as the cause for foreign dependencies, the specific example cited was the offshore assembly of semiconductors, the so called back end portion of the semiconductor manufacturing process discussed earlier. Beyond this specific example, the JLC discussed the broader issues of foreign cost advantages in labor, capital costs and currency exchange. Regarding labor, the U.S. has substantially higher wage rates than most of its trading partners. In

1982, against a U.S. baseline index of 100, West Germany had 89, Japan 49, Singapore 17, Hong Kong and Taiwan 12, and Korea 10, according to Department of Labor data, cited by the JLC. In terms of capital costs, based on Government monetary, fiscal and subsidy policies in 1981, the average weighted cost of capital to industry was as follows: U.S.-16.6%; France - 14.3%; West Germany - 9.5%; and Japan - 9.2%. In 1971, the range between the U.S. and Japan was much less, 10.0% vs 7.3%, respectively. Another item affecting U.S. industry's ability to invest in productivity enhancing capital equipment is depreciation rates, which have been historically much lower in the U.S. than in other major industrialized countries, particularly Japan. The JLC also cited the overvalued dollar as a primary source of cost differential, prior to the revaluation that occurred in the fall of 1985.

Quality issues show up in unexpected places. For example, one of the bomb producers participating in the Industrial Responsiveness Analysis (IRA) revealed that German steel was used because it caused fewer rejects than domestic steel. Closely related to the quality issue, not in raw materials but in assembled subsystems, is that of superior foreign technology. The JLC noted many instances of foreign sourcing of assemblies because the items outsourced were considered to be technologically superior to comparable items produced in the U.S..

Policy/Programs

The second category of causes of foreign dependency, unlike basic economic interdependence which normally transcends the ability of DoD to influence, relates to the effects of specific DoD policies and their related programs.

A policy trichotomy exists within DoD between three conflicting goals. The first is a growing emphasis on NATO Rationalization, Standardization and Interoperability (RSI), for which the proponent is the Office of the Assistant Secretary of Defense for International Security Affairs. Simply stated, this policy emphasis calls for greater cooperation with NATO as a means of strengthening the military capability of the alliance. By definition, greater cooperation includes actions which are intended to strengthen the "NATO Industrial Base" by removing barriers to increased NATO participation in U.S. weapon purchases. DoD 2010.6, Standardization and Interoperability of Weapons Systems and Equipment within the North Atlantic Treaty Organization, among other things, encourages: (a) foreign participation as subcontractors to U.S. prime contractors; (b) teaming, licensing or subcontracting arrangements between firms of two or more NATO nations; and (c) NATO industrial participation at the earliest possible time in R&D projects. Finally, NATO contractors from countries with which the U.S. has general and reciprocal Memoranda of Understanding shall be afforded the

opportunity to compete for DoD procurement. These policies were emphasized by a 6 June 1985 SECDEF policy statement, Emphasis on NATO Armaments Cooperation.

The second policy goal is the "U.S. Mobilization Base," which was first defined by a Defense Mobilization Order in 1952, as the U.S. was building up for a potential conflict with the Soviet Union. The policy is presently articulated in the Defense Mobilization Order (DMO), Maintenance of the Mobilization Base, CFR Title 44, Chapter 1, Part 321. This DMO calls for the maintenance of a sustained state of mobilization production readiness. Specifically, the facilities, machine tools, production equipment, and skilled workers necessary to produce wartime requirements are to be maintained for immediate use in an emergency.

Within DoD, industrial base policy documents are the responsibility of the Office of the Assistant Secretary of Defense for Acquisition and Logistics. The applicable documents essentially call for the maintenance of a state of industrial preparedness to meet surge and mobilization requirements. The operative industrial preparedness documents are DoD 4005.1, DoD Industrial Preparedness Production Planning; DoD 4005.3, Industrial Preparedness Planning; and DoD 4005.3M, DoD Industrial Preparedness Planning Manual. These policy documents limit industrial preparedness planning to producers located in the U.S. and Canada. Other documents in the 5000 acquisition series address other aspects of the industrial base issue, in effect, cutting both ways to the policies contained in DoD 2010.6 and the 4005 series documents. Maximum cooperation with allies in the acquisition of defense systems is called for, with caveats that mobilization requirements must be considered and that a strong industrial base is essential and the impact of DoD acquisitions must be considered.

Yet a third policy goal is competition. With the passage of the Competition In Contracting Act and the establishment of competition advocates throughout the procurement structure, there has been a priority given to competition which, according to the IRA and other studies, is not always balanced by mobilization base considerations. This is the case notwithstanding the existence of exclusions in the Federal Acquisition Regulations (FAR) to preserve mobilization capability. Carried to its extreme, competition could be inconsistent with either of the other goals. For example, a contract awarded to a non-NATO foreign firm would comply with neither NATO RSI goals nor those of protecting the U.S. mobilization base.

The practical effect of this trichotomy is that the program manager who is responsible for developing and executing the acquisition program has no clear guidance on how to resolve these different priorities. As a result, the real world procurement

policies and practices do not adequately address the issue of foreign dependency. There is little specific guidance at the component level and foreign dependency is not an issue of high priority with program or project managers.

According to the JLC report, the root cause of the existence of foreign dependency in U.S. weapons systems is the failure of DoD to manage the problem. According to this view documented in the report, adequate authorities exist to protect the U.S.industrial base from inappropriate and damaging levels of foreign sources which would inhibit the ability of the industrial base to respond to the production requirements of surge or mobilization. The problem is not the lack of authority or management tools but a failure to devote necessary resources to the task of managing foreign dependency.

Finally, other studies noted that no effective organizational responsibility exists for addressing foreign dependency. It is the job of everyone and no one and, without an oversight organization acting as a monitor to the problem, foreign dependencies become ingrained without due consideration of possible crisis consequences. It is interesting to note that, in July 1986, the Army Material Command took action to create a Production Base Advocate whose task it will be to inject industrial base surge and mobilization issues, to include foreign dependency, into the Army's acquisition process.

Conclusions for Surge and Mobilization

General

Foreign dependency is a national security issue. This is certainly true in terms of our ability to expand production in a national security emergency, either a peacetime surge or a wartime mobilization.

With the exception of critical and strategic materials which the nation has stockpiled since World War II, foreign dependency is a relatively recent phenomenon. Certainly it was not a problem throughout the 50's and 60's when the U.S had the world's dominant manufacturing economy as a foundation for the defense industrial base. Foreign dependency has evolved without a lot of fanfare and, as noted elsewhere in this report, without a lot of visibility. Much of it has been a natural outgrowth of the economic interdependence and the changing relationship of the U.S. economy vis-a-vis the rest of the world. The real issue, beyond its apparently growing pervasiveness, is that it is not being adequately dealt with. The studies note that no positive action has been undertaken to correct or mitigate foreign dependency, in any focused, comprehensive way. Neither have any accommodative steps been taken to assure not only continued but ex-

panded availability from foreign sources in a time of crisis.

Consideration of the implications of foreign dependency tend to fall into two extremes. At one end is the assumption that foreign dependencies will have no impact upon production because our suppliers will be completely reliable, by intent and by all circumstances of physical reality. At the other end is the potential for serious production problems due to a total cutoff from foreign sources. The real answer is probably somewhere in between. As noted earlier, this question will be the subject of further work by MCDC. However, until foreign dependency is positively managed by DoD, its circumstances and implications completely understood and steps taken to mitigate U.S. vulnerability, foreign dependency will remain a national security problem of unknown dimensions.

To the degree that the foreign dependency problem can be solved within DoD's responsibilities and resources, solutions should comprise a combination of improved mobilization planning and increased emphasis within the acquisition process. Neither can be effective if pursued alone. Mobilization planning is essential because it provides the basis for an efficient transition to the expanded demand of an emergency. The day to day acquisition and procurement process, however, provides the real world baseline of production capability which is the starting point for surge or mobilization. It is in acquisition and contracting that foreign dependencies are created unless action is taken to maintain a domestic capability.

According to the JLC study, the impacts of foreign dependency can be reduced, and in some cases eliminated, through informed management of system development and procurement. The basic premise from which this is derived is the view that a principal reason that foreign dependency exists in weapons systems is that DoD is not properly managing it. A lack of attention by program managers and procurement officers, caused in part by a lack of analytic and management tools with which to deal with foreign dependency problems, has substantially created the existing situation. According to this view, if institutional changes by acquisition and procurement decision makers are mandated and supported by a functioning system for identifying and managing foreign dependencies, remedial actions are possible to reduce the impact of foreign dependency.

Another study noted that DoD funding programs basically focus on weapon systems and, by extension, the facilities held by the prime contractor. Rarely does funding support for production capability get down the subtier structure to the component level in an industry like semiconductors. Those instances of support to a lower tier industry, through Title III of the Defense Production Act, typically address strategic and critical materials. Although support was provided to industries other than

materials during the Korean War era, no plan presently exists to improve domestic component industries, notwithstanding the fact that they are the source of much of the foreign dependency problem.

Table 2

GENERAL CONCLUSIONS

		Source(s)
1.	Foreign dependency is a national security issue.	JLC
2.	Solutions must include both improved mobilization planning and acquisition contracting emphasis.	JLC
3.	Impacts of foreign dependence can be reduced, in some cases eliminated, by managing the problem.	JLC
4.	DoD industrial programs focus on critical materials stockpiles and weapons systems. No plan exists to improve domestic component industry.	NRC
5.	DoD must commit resources to deal with foreign dependency problems or accept unknown risks.	JLC
6.	Lack of action by DoD will result in increasing foreign dependence in future weapons systems.	JLC
7.	Sufficient legal and regulatory means exist to protect the U.S. industrial base, to whatever level deemed necessary (see Potential Restrictions in Defense Trade, Table 4).	ICAF

Consistent with the discussion earlier regarding the fact that foreign dependency is a national security issue, it is clear that management resources must be committed to dealing with the problem or DoD must accept unknown, unquantified risks. And, all indications are that a lack of action will result in increasing foreign dependence in future weapons systems, particularly given the lack of emphasis and lack of analytic tools. In responding

to a Congressional requirement to evaluate proposed legislation to restrict trade in defense materiel, an Industrial College of the Armed Forces (ICAF) study concluded that trade restricting legislation is not in the best interests of DoD. The study also noted that sufficient legal and regulatory means exist to protect the U.S. industrial base, to whatever level deemed necessary. Given emphasis by senior leadership, more effective practices for maintenance of the base could be undertaken with no change to current law and regulation and without violating any current international agreements to which the U.S. is party. See Table 2 above.

Table 2 above provides the general conclusions regarding surge and mobilization. The following section provides the conclusions contained in the three industry specific reports on microelectronics, ferroalloys and bearings.

Industry Specific Studies

Microelectronics

Electronic component dependency has grown in recent years and will increase in the future. This judgement was made in the context of U.S. Army systems but applies to all military users of semiconductors. Dependency for electronic components exists at several levels. First, there are a number of items that are exclusively foreign sourced, such as ECM tubes, certain video displays and magnetic materials and products. Compound semiconductors, especially gallium arsenide devices, are substantially sourced from offshore. The second problem, identified earlier in this report, is that of offshore assembly and test of U.S. manufactured semiconductors, the so-called back end production. Yet another dependency has to do with foreign supplied or controlled content such as ceramic packages.

Regarding the problem of offshore assembly and test, one view expressed in a report by the Institute for Defense Analysis (IDA) is that geographic dispersal over a number of sites in the Far East reduces vulnerability that might exist if the industry's back end operation were at a single location or area.

Proposals have been made to encourage expansion of the back end operation into the Caribbean in lieu of the Far East, for several reasons. Desires to promote political stability through economic growth were the basis for the President's Caribbean Basin Initiative. Another reason, from a foreign dependency standpoint, is the belief that facilities in the Caribbean region would be inherently less vulnerable than those in the Far East. IDA examined this issue in some detail, reviewing existing studies and interviewing responsible individuals in industry. IDA concluded that it is unlikely that U.S. semiconductor

companies will move into the Caribbean, for several reasons. Central and South America are not seen as potential major future markets so there is no appeal from a market penetration standpoint, unlike areas that would open the European market, such as Ireland and Scotland. Low wages are not an issue, as they might have been years ago, because most of the high technology aspects of assembly are now automated. The U.S. executives had a low opinion of the labor force, in terms of technical skills and in terms of the region's work ethic if skills were available. The validity of IDA's assessment is supported somewhat by a recent decision by a major semiconductor manufacturer to move its domestic back end operations to the Far East. Contrasted to a lack of technical skills in the Caribbean, Far East sites such as Singapore, Bangkok and Malaysia, possess, by all accounts, a highly skilled technical and managerial infrastructure which is actively supported and enhanced by the local governments.

The erosion of the market position of the U.S. semiconductor industry has become an issue of increasing concern, raising questions about the survival of individual U.S. companies and possibly even the entire semiconductor industry in its present form. There has been a virtual upheaval in the commercial microelectronics industry, most directly felt in the last five years. The speed with which the Japanese have captured large shares of the market is startling. And the Koreans and other Asian countries, while perhaps not yet on the leading edge of technology, are pressing hard in their efforts to compete. Beyond issues of U.S. surge and mobilization production capability, serious technological concerns are raised, which will be addressed later.

According to a June 30, 1986 OSD report to the House Appropriations Committee, the available evidence suggests that the use of foreign microchips does not appear to impair current readiness or sustainability. Currently, the direct evidence does not support a conclusion of an inability to meet U.S. warfighting requirements for microelectronic components. While the potential for impairment of surge production exists, the report states that it is not possible to fully evaluate the implications of the existing dependencies without a more systematic collection of information. While seemingly inconsistent with the JLC report which identifies the serious impact of cutoff, the report gets at the crux of several issues noted earlier. One is the general lack of information regarding foreign content in weapons systems, visible and invisible. Another is the issue of dependence vs. vulnerability which will be explored in a follow-on MCDC report. At what point and under what circumstances does a foreign dependency translate into an inability to meet warfighting requirements? In effect, the OSD report is saying that question hasn't been answered.

The same report states that actions to reduce foreign dependency by restricting DoD purchases to domestic sources can have undesirable cost and quality impacts upon weapon systems. A more appropriate response, the report implies, would be U.S. Government creation of an economic climate in which U.S. producers can remain competitive (or recover competitiveness).

In another report, one by IDA discussed earlier in this section, the relative inability of DoD to control the U.S. electronics industry was noted. This is because of the relatively small share of the electronics market represented by DoD driven purchases (about 5 percent) and because the majority of defense purchases are for devices considered obsolete by industry standards. DoD does have an opportunity to influence the industry, by offering incentives in four areas, i.e., procurement practices, specifications, technology and economics. It is important to understand, however, that there is a significant difference in context between the IDA report published in November 1985 and the recent OSD report, which also had IDA input. The conclusion of the former is in the context of DoD's ability to influence an industry within the resources of DoD procurement programs. The context of the latter, which has been influenced by considerations of the Defense Science Board, is a potentially broader U.S. government response which would not necessarily be limited to DoD programs or current resources.

Ferroalloys

DoD, in the 1986 Defense Authorization Act, was requested to "conduct a study to determine what effect a loss of all capacity by the United States to produce domestic ferroalloys would have on the defense industrial base and on industrial preparedness of the United States." This requirement formed the first assumption for a study by the Logistics Management Institute (LMI), i.e., that no domestic capability would be available for the production of ferroalloys. Five additional assumptions were made, which are important to understanding the conclusions identified in Table 3.

1. Plants can be converted from the production of one ferroalloy to certain other ferroalloys with specified losses in efficiency.

2. All existing unused processing capability is immediately available when needed, and no lead time is necessary to establish an infrastructure for its use.

3. No country except the U.S. increases steel production.

4. No shipping losses occur.

5. U.S. demand has priority over that of other countries.

The earlier discussion of the problem of ferroalloys identified the diminished condition of the U.S. ferroalloy industry. The study concluded that, if the assumption of total loss of U.S. capacity does not come to pass, the current U.S. ferroalloy capacity just meets the nation's mobilization needs in circumstances of most extreme disruption. The study looked at the effects of progressive disruption as follows: (a) no supply disruptions, (b) disruption of supply from Republic of South Africa, (c) disruption of all of Africa, and (d) disruption of all of Africa and all of Europe.

If the U.S. capacity were lost, given the basic assumptions, mobilization shortages would appear in each of the scenarios, with progressive severity and broadening of types of ferroalloy shortages. For example, under conditions of no supply disruption, shortages of silicon metal appear and the U.S. would need to build 50,000 tons of processing capacity. Under the worst case, all of the ferroalloy industries would be short processing capability, with only ferromanganese stockpiled in adequate quantities. The U.S. would need 1.4 million tons of processing capability and U.S. ore production would be required.

The requirement to build processing capacity in an emergency is severely complicated by the study's conclusion that the U.S. and Canada do not now have the capability to construct new processing plants. Only three western firms have that capability, one each from Japan, West Germany and Norway.

Although the study states that U.S. capacity appears to have stabilized, the situation described is unrealistic in terms of U.S. mobilization capability in that each of the five listed assumptions would have to be met.

Bearings

The Joint Logistics Commanders were requested by the DEPSECDEF to prepare a report requested by Congress on the U.S. bearing industry. The JLC established a Joint Bearing Working Group (JBWG) which included members from the Services, Defense Logistics Agency and two civil agencies, the Department of Commerce and the U.S. International Trade Commission. The summarized conclusions of the JBWG report contained in Table 3 provide substantial detail which requires only a little additional explanation. Basically, the conclusions describe an industry that is critical to weapon production and, therefore, national defense. The industry is in trouble due to import penetration in the commercial market and, increasingly, in defense production as well. DoD can take positive steps to

assist the industry but a broader effort involving trade and economic issues is required, founded upon a national policy stating that a domestic bearing industry must be developed and maintained.

Table 3 summarizes the defense study conclusions for microelectronics, ferroalloys and bearings.

Table 3

INDUSTRY SPECIFIC CONCLUSIONS SURGE AND MOBILIZATION

Microelectronics	Source
	NRC
1. Electronic component dependency has grown recently, will increase in future.	
a. Geographic dispersal of offshore U.S. merchant capacity reduces vulnerabilities.	IDA
b. Caribbean basin is not a viable alternative to Far East assembly and testing.	IDA
2. Market position of U.S. semiconductor has eroded substantially over last two decades; trends indicate erosion will continue.	OSD
3. No direct evidence of inability to meet U.S. warfighting requirements for microelectronic components.	OSD
a. Potential for impairment of U.S. industry's ability, in worst case scenario, of surging production.	OSD
4. Actions to restrict DoD purchases to domestic sources could have undesirable cost and quality consequences.	OSD
5. U.S. Government can help by creating climate in which U.S. producers can remain competitive.	OSD
o DoD cannot control U.S. electronics industry but can influence it.	IDA

TABLE 3--Continued

Ferroalloys		
1.	Current U.S. capacity, if retained, just meets needs of mobilization in circumstances of most extreme disruption.	LMI
2.	If U.S. ferroalloy capacity lost, severe shortages of ferroalloys occur in a mobilization, the degree and mix depending upon the amount of disruption.	LMI
3.	New processing and mining capacity would have to be built.	LMI
4.	U.S. and Canada do not now have the capability to construct new processing plants.	LMI
Bearings		
1.	A strong U.S. bearing industry is essential to a strong industrial base and is therefore critical to national defense.	JBWG
2.	A strong commercial/commodity base is needed to support the DoD segment of market; DoD peacetime requirements are insufficient to support bearing industry.	JBWG
3.	The U.S. bearing industry is losing production capacity and capability due to loss of commercial market share.	JBWG
4.	Foreign bearings, to include superprecision, are increasing in military applications.	JBWG
5.	A government requirement to use domestic bearings in military applications will: a. Help ensure domestic sources by contributing to the survival of the U.S. bearing industry. b. Not ensure the survival of the bearing industry as a whole. c. Not address all the problems facing the U.S. bearing industry.	JBWG

TABLE 3--Continued

	d. Not prevent foreign manufacturers from dominating the commercial market.	
6.	To become competitive, the U.S. bearing industry must invest more in capital improvements and R&D.	JBWG
7.	Industrial Modernization Incentives Program (IMIP) and Title III, if adequately funded, could help the industry modernize and become more competitive.	JBWG
8.	An interagency group is required to address trade and economic issues confronting the U.S. bearing industry.	JBWG
9.	A national policy is needed to develop and maintain a complete domestic bearing manufacture capability.	JBWG

Other Studies for Congress

Offsets

Section 309 of the Defense Production Act (DPA) Amendments of 1984 (P.L. 98-265) required the submission of a report on the impact of offsets on the defense preparedness, international competitiveness, employment and trade of the United States. The first report was due 18 months after the DPA was extended, with an annual report required thereafter. The Office of Management and Budget (OMB) was named as the lead agency for the report, which was developed by a working group with representatives from the Departments of State, Treasury, Defense, Commerce, and Labor; the Federal Emergency Management Agency, the Arms Control and Disarmament Agency, the Central Intelligence Agency; the United States Trade Representative; and the National Security Council. The initial report was submitted to Congress on 11 February 1986.

Offsets are a relatively new phenomenon but one that may be expected to increase in terms of its required application by foreign purchasers. An offset is essentially an arrangement by which the foreign purchaser of military items (and, increasingly, non-military items such as civil aircraft) requires the U.S. seller to accept some form of compensation besides hard currency, often some type of product. Offsets cover a broad range of industrial and commercial compensation practices, which for the

purposes of the OMB report, include the following: coproduction, licensed production, subcontractor production, overseas investment, technology transfer and countertrade, which would include barter, counter-purchase and compensation (buy-back). The administration does not consider coproduction to be an offset but included it in the report because Congress specifically cited it.

Offsets have become controversial, principally because of their growth as a method of foreign countries doing business with U.S. firms but also because of the growing perception that they are having an increasingly negative effect upon the U.S. industrial base, particularly the subcontractor structure. The IRA and the Gas Turbine Engine studies raised this issue. It should be noted that it is DoD policy, established in 1978, to not normally enter into such agreements. In effect, the agreement is between the buyer and the U.S. selling company.

The conclusions reflected in Table 4 reflect another aspect of the controversy regarding offsets. Studies which have specifically explored the capability of U.S. industry to rapidly expand production to meet emergency military demands, have identified offsets as having a negative impact upon domestic subtier industrial capacity and therefore, upon surge capability. This conclusion essentially comes from industry itself, which heavily participated in the Industrial Responsiveness Analysis and the Gas Turbine Engine Study. The OMB report, while agreeing that offsets are increasing foreign competition at the subcontractor level, basically says that offsets are not now a problem and, under certain circumstances, may be in the national interest. Perhaps the definitive conclusion about offsets is item 8 in Table 4. Offsets are a fact of life and increasingly are the entry price for competing in the international market.

Potential Restrictions in Defense Trade

The DoD Authorization Act of 1985 included a requirement for a Study of Foreign Sales and Procurement of Defense Articles. The study, among other things, was to assess the effects of a number of potential legislative restrictions on the procurement of foreign component defense articles. A study was developed by ICAF to respond to the Congressional requirement. Several of the principal conclusions of the ICAF study are related to the offset issue and are consistent with the OMB report. Foreign military sales and direct commercial sales have a positive impact on the U.S. industrial base by providing additional markets for defense articles, thereby providing economies of scale and larger production runs. The ICAF report concludes that the benefit accruing to the U.S. base is diminished somewhat by offsets but makes similar arguments to those identified in the OMB report, i.e., that offsets are a cost of doing business and a diminished sale is better than no sale at all.

A second conclusion is based on "a striking lack of data relating to the effects of trade in defense goods on the industrial base". Because of the lack of data, any analysis of the effects of proposed trade restrictions must be conjectural and premised on the theory and mechanics of international trade.

ICAF concluded that trade restricting legislation was not in the interests of DoD in a peacetime economy. While sales by the U.S. industrial base would increase, such a policy would incur risks of increased costs, longer delivery times and the wrath of other governments against whom the U.S. is bound by agreement not to discriminate.

Table 4

OTHER CONGRESSIONAL STUDY CONCLUSIONS

SURGE AND MOBILIZATION

Offsets	Source(s)
1. Co-production and offsets reduce domestic subtier industrial capacity.	IRA
a. Offsets are increasing foreign competition at subcontractor level.	GTE, OMB
b. May be contributing to erosion of U.S. subcontractor base.	GTE
c. Current burden is on subcontractors; long term effect may be on primes.	GTE
2. Offset agreements have resulted in the establishment of offshore manufacturing capability that may not be available when needed.	GTE
o Offsets are passing advanced materials and processing technologies offshore and thereby diminishing domestic capacity.	GTE
3. Consortium agreements between U.S. and foreign producers are becoming more prevalent in the gas turbine engine sector. Production may be extremely vulnerable to disruption in a crisis.	GTE

TABLE 4--Continued

4.	Coproduction and some offsets contribute to RSI.	OMB
5.	Arms transfers are in the national interest -- to the degree that offsets cause them to happen, they have a positive influence.	OMB
6.	No capacity problems exist, caused by offsets.	OMB
7.	Evaluation of impact upon subcontractors is difficult; one cannot evaluate business lost vs. business which would have been lost except for offsets.	OMB
8.	Offsets are required for U.S. defense contractors to participate in the international market and remain competitive.	OMB
	Potential Restrictions in Defense Trade	
1.	Foreign military and direct commercial sales have a positive impact on the U.S. industrial base.	ICAF
2.	No one can definitively assess the impact of trade upon the industrial base.	ICAF
3.	Trade restricting language not in best interests of DoD in a peacetime economy.	ICAF
4.	No need to enact new law or violate international agreements to more effectively maintain the industrial base.	ICAF

If the goal is to enhance and maintain the U.S. industrial base, there is sufficient legal and regulatory means to protect the U.S. industrial base (See Table 2, item 7). ICAF sees U.S. industrial base issues as secondary to RSI in the 70's and perhaps tertiary to competition in the 80's. In effect, the issue isn't means but emphasis, leading to the last conclusion. There is no need to enact new law or violate international

agreements to more effectively maintain the U.S. industrial base.

Table 4 above summarizes conclusions regarding offsets and potential restrictions in defense trade.

C. Technology

Up to this point, the discussion of defense studies surveyed has focused on the efforts of foreign dependency upon surge and mobilization capabilities. Another problem, much less documented in terms of a focus upon defense impacts, is that of technology. This section will focus on the circumstances of technological dependency.

Problem

The principal area of technological concern is in the electronics area and, more specifically, the various industries associated with the manufacture of semiconductors. Other technological dependencies exist, but none which have such a pervasive presence in current and future defense systems.

The crux of the technological problem was expressed in the OSD report to the House Appropriations Committee on electronic microchips, which was discussed earlier in the surge and mobilization section. Specifically, competitive forces in the worldwide semiconductor industry threaten the U.S. technological leadership. Within the next decade, the possibility exists that the U.S. may become dependent upon foreign sources for semiconductors. Therefore, according to this view current dependencies upon foreign sources are a lesser concern than the long-term viability of the U.S. semiconductor technology base.

Examples of existing dependencies which may be forerunners to broader problems follow. Gallium arsenide (GaAs) devices are critical to advanced weapons systems, for reasons which include their higher speed and radiation resistance. According to the National Research Council study, Production of Electronic Components and Army Systems Vulnerability, there is substantial DoD-sponsored R&D in gallium arsenide semiconductors but little U.S. manufacturing capability. Unless current R&D and production capacity trends are reversed, Japan will become the dominant source for high performance gallium arsenide substrate material and semiconductor devices. The NRC study states the essentiality of the capability to produce GaAs in the U.S. because of the custom design requirements for systems specific chips.

Dynamic random access memories (DRAMs) are a current leading edge silicon based product of great importance in the commercial

market. According to material presented to the Defense Science Board and published elsewhere, DRAMs are the technology driver for development of newer high-density processes and advanced product designs for a broad spectrum of device technologies. DRAM's also provide the high volume cash cow needed to finance increasingly expensive facility investments required to compete in advanced semiconductor products. U.S. firms are losing market share in advanced, high-density and high-performance silicon integrated circuits, of which DRAMs are the most prominent. Japan dominates the 256K DRAM market, is apparently far ahead in the next generation one megabit DRAM and a number of Japanese firms are working on 4 megabit DRAMs. The Japanese domination of memory devices led to a trade complaint by several U.S. semiconductor manufacturers, charging dumping at below fair market value.

Electronic Industry Trends/Situation

The U.S. semiconductor industry may be characterized as either merchant or captive. The former make their product for sale and include firms such as Texas Instruments, Motorola, Intel and many more. The captive producers manufacture for their own use. The dominant companies are IBM and AT&T.

A fundamental concern from the standpoint of continued technological leadership is the health of the U.S. merchant industry. Representatives of the semiconductor industry have expressed the view that the captive producers, notwithstanding their broad technological capability and current good health, cannot be expected to carry the entire load of maintaining U.S. technological leadership across the entire spectrum of militarily essential electronics technology. According to information made available to the Defense Science Board, U.S. sales of integrated circuits were 3 times those of the Japanese in 1979. In the first two months of 1986, sales of integrated circuits were $.96 million for U.S. companies compared to $1.03 million for Japanese companies. In terms of market share, the merchant's share of the domestic market has fallen from 58 percent in 1984, to 50 percent in 1985 and a projected 48 percent in 1986. In the case of DRAMs, the U.S. industry has shifted from complete domination of the market in 1970, to a predicted market share approaching zero in 1987. DRAMs represent about 10 percent of the total integrated circuit market,with sales of about $2 billion in 1986, projected to reach $6 billion by 1990. Currently the Japanese hold 95 percent of the world market for the 256K DRAM and, as noted earlier, are posturing themselves to dominate the 1 and 4 megabit DRAM markets.

A result of the loss of market share will be a growing inability to fund R&D and make capital investments at levels high enough to allow the companies to remain competitive. There will

be an accelerating spiral of less market share and less investment, ultimately leading to a dramatically less capable semiconductor industry than presently exists. The situation is further complicated by the fact that new devices are increasingly costly, both in terms of development and in terms of the facilities required to manufacture the item. Given the large investments required to participate in new technologies, market share is critical, particularly for high volume items such as DRAMs discussed above. Charles H. Ferguson, who has recently performed in-depth research of the U.S. microelectronics and computer systems industries in pursuit of a Ph.D. from the Massachusetts Institute of Technology, believes that the only salvation of the U.S. merchant industry will be a dramatic restructuring and rationalization which would provide the economies of scale to allow competition with the vertically integrated Japanese firms.

The U.S. semiconductor equipment industry, which provides the machine tools of the electronics industry, is in similar straits. It is losing market share and technological leadership. The Board on Materials Science of the National Materials Advisory Board conducted a review which has recently been published. Although technically not a "defense study" in the context of the others discussed in this report, the review entitled Advanced Processing of Electronic Materials in the United States and Japan is relevant here.

The past, and until recently, very successful development of the U.S. semiconductor industry, has been intimately tied to advances in surface processing techniques originated in U.S. laboratories. The semiconductor technology of the future will involve small integrated circuits, more complex device architecture and innovative uses of new materials. According to the report, the Japanese are ahead in making a long-term commitment to the development and exploitation of these new manufacturing techniques. Of 11 key areas of advanced processing R&D, the U.S. retains a technological edge in only three: ion implantation, thin film epitaxy and film deposition and etching. This last year, the U.S. lost control of optical lithography. In the remaining areas, the Japanese hold a clear edge. At least 10 Japanese firms are working in the development and application of advanced process technologies, looking out 7-10 years. No more than two U.S. firms are similarly involved.

According to the report, the future of electronic materials and devices depends entirely upon the development of advanced processing technologies. Without competency in processing technology, the U.S. could become dependent on foreign sources for advanced electronics devices essential to computer technology, the communications industry and, most important to this review, advanced defense systems.

The implications of a loss of technological leadership in

semiconductors could be reduced effectiveness of U.S. defense systems. Semiconductors are the key building block for electronics used in most military weapon systems. Electronics provide the qualitative edge in our military hardware that will allow the U.S. to overcome the dramatic quantitative superiority of the Soviet Union.

Another implication occurs in the development of new systems. Given foreign sources, it will be very difficult to control research and development priorities and develop new systems in a timely manner.

Given the absolute U.S. need for qualitatively superior weapons, both for warfighting and for deterrence, the potentiality of not being able to control our technological destiny has to be of fundamental concern. The Defense Science Board and the National Security Council have been examining the semiconductor industry. OSD, in its report to the HAC, has indicated that it will take action in accordance with the recommendations of these two groups to assure the continued viability of the U.S. technology base for the development and production of future generations of microelectronic components. Both reports should be available sometime in the fall of 1986.

As a footnote, based on U.S. industry complaints of unfair trade practices by Japan, trade negotiations were initiated to seek relief in several product lines, to include 256K and future generation DRAMs. On 31 July 1986, the Administration announced an agreement with Japan which will open the Japanese market to increased sales of U.S. semiconductors. Also, according to administration officials, the Japanese promised to stop selling products at below fair market value.

D. Solutions

At tables 5 and 6 are the proposed solutions put forward by the several studies. No attempt is made to differentiate between surge/mobilization and technology solutions. Since few of the studies explicitly dealt with technology issues, the NRC report on foreign production of electronics and the OSD report to the HAC on microchips being the principal exceptions, most of the solutions address surge and mobilization issues. Table 5 provides the general solutions and are derived from the studies that are not industry specific but are generally applicable to many defense industries. Table 6 addresses the solutions identified in the several reports made to Congress at their request, covering the microchip (semiconductor), ferroalloy and bearing industries.

The general solutions are organized into two basic categories, substantive and procedural or policy solutions. Most of

the solutions are self-explanatory. They all derive from earlier identified problems, causes, and conclusions and have an inherent logic, providing one accepts the basic description of circumstances contained in each report. Many of the solutions, particularly the substantive ones, would require detailed analyses of cost effectiveness prior to development of actual funding programs. All presume that the basic problem, foreign dependency, should be addressed and, in general, in an active manner as opposed to an accommodative approach. The latter is implied in some of the procedural and policy solutions and, in point of fact, may be the only realistic solution for some specific problems upon detailed examination.

Table 5

SOLUTIONS PROFFERED - GENERAL

Substantive solutions	Source(s)
1. Fund Government ownership/subsidization of facilities/equipment.	JLC, IRA, NRC
2. Allocate dual source funding and qualify domestic sources.	IRA, PGM
o Require at least one domestic source for components.	NRC
3. Stockpile critical components and materials.	JLC, IRA, PGM, NRC
4. Subsidize large working inventories by prime contractor.	IRA
5. Fund expansion of domestic capacity with Defense Production Act, Title III.	JLC
6. Fund MANTECH to establish domestic capacity.	JLC, GTE
7. Fund targeted DoD investments to component industry.	NRC
8. Redesign to eliminate component dependency.	NRC

TABLE 5--Continued

Procedural Policy/Solutions	Source(s)
1. Make foreign dependency control a policy issue.	
a. Obtain visibility of foreign dependence in weapon systems.	JLC, NRC, ICAF
b. Establish an Office of Primary Responsibility at OSD and Services to track, analyze and report on foreign reliance and take action to safeguard the U.S. industrial base.	ICAF
(1) Provide regular reports to SECDEF and Service Secretaries.	
(2) Consolidate reports, send statements to Armed Services Committees on extent of foreign dependence in DoD weapon systems.	
c. Establish/maintain data base/management information system.	JLC
d. Increase planning, on DoD wide basis, to address foreign dependence.	PBA
2. For current systems:	
a. Establish program manager as responsible and set policy requiring that the problem be addressed.	NRC
b. Establish criteria for assessing foreign dependence.	NRC
c. Require assessment of foreign dependency throughout life cycle.	JLC
d. Require prime contractor to fully define foreign dependencies in surge planning.	PGM
3. For future systems:	
a. Generate policies, set responsibilities, set criteria.	NRC
b. Identify future dependencies for next generation of weapons.	NRC
c. Require stringent evaluations of foreign dependencies during SAR, PRR, DSARC.	JLC, ICAF
d. Require impact analysis and contingency plans for critical sole source components.	JLC, NRC
4. Conduct a pilot program to develop an analysis methodology and data collection.	JLC

TABLE 5--Continued

5.	Require semiconductor industry to perform mobilization contingency planning.	IRA
6.	Develop/adopt mechanisms to be used in crisis.	IRA
	a. Plan for substitutions - components or systems.	JLC
	b. Fund R&D to develop replacement or substitute capability.	JLC
	c. Reduce product specification requirements.	IRA, JLC
	d. Enforce Defense Priority and Allocation System to gain access to available domestic capacity.	JLC
	e. Establish standby voluntary agreements.	JLC
	f. Fund determination of suitability of epoxy packaging for semiconductors.	PBA
	g. Purchase design rights for all foreign items.	JLC
7.	Use Exception 3 of Competition in Contracting Act to protect the domestic industrial base.	JLC
8.	Obtain delivery commitment for foreign source components.	NRC
9.	Require prime contractor to guarantee component supplies.	NRC
10.	Accomplish common buying for critical components.	NRC
11.	Fund the development of electronics inspection technology to reduce labor cost.	PBA

The message that comes across in the general solutions is that foreign dependence should be made a specific policy issue, that specific organizations and managers should be made responsible for dealing with the problem, and that foreign dependency should be actively managed throughout the life cycle of systems. In order to successfully manage the problem, data bases and management approaches must be established. Criteria for assessing foreign dependence must also be established, principally because the problem, from a cost effectiveness standpoint, may not be solvable for many items. In those instances in which a decision is made to accept foreign dependency in peacetime, mechanisms need to be developed and adopted to deal with the issue when a crisis arises.

Regarding the industry specific solutions (Table 6), the OSD report on microchips essentially defers to the forthcoming recommendations of the Defense Science Board and the National Security Council Studies. The recommendation for ferroalloys appears mundane at first blush but is significant. One of the principal problems in weapon systems is a lack of data and visibility in foreign dependency. The ferroalloy study basically calls for going beyond the current practice of maintaining weapons specific data. It recommends development of a system to provide for the visibility and monitoring of essential basic industries. The real message here, reinforced by the bearing study, is the need for a defense monitoring of the health of all basic industries essential to mobilization production. This basic need will be strongly confirmed by the review of civil industry studies which follows.

Finally, the report on the U.S. bearing industry provided a comprehensive review of the foreign dependency situation and identified a coherent set of recommendations consistent with the needs of national defense. The solutions are two-fold; those which are beyond the responsibility of DoD and which involve basic economic and trade issues; and those which fall within the purview and capability of DoD to fix. Table 6 provides the details of the proposed solutions.

Table 6

SOLUTIONS PROFFERED - INDUSTRY SPECIFIC

Electronic Microchips

Based on the conclusions and recommendations of on-going Defense Science Board and National Security Council studies of the U.S. merchant semiconductor industry, DoD will initiate action, as appropriate, to:

-- Assure the continued availability of semiconductor devices.
-- Assure the viability of the U.S. technology base for the development and production of future generations of microelectronic components.

Source - OSD

Ferroalloys

DoD should monitor trends in domestic processing capacity and be prepared to react to any further significant erosion of ferrochromium, ferrosilicon and silicon metal processing capacity.

Source - LMI

Bearings

1. An interagency group chaired by the Secretary of Commerce should be established to investigate the following issues:

a. Analyze imposition of temporary import restrictions, combined with domestic producer plans for facility modernization and work force training programs.
b. Analyze temporary anti-trust exemption to allow consolidation and rationalization of production.
c. Analyze tariffs, quotas and other U.S. and foreign trade restrictions on bearing parts, components and steel.
d. Restrain the transfer of bearing technology offshore by limiting the number of production agreements.
e. Review industry concerns regarding anti-dumping laws to determine their effectiveness in discouraging dumping and unfair market practices.
f. Study the impact of imports on U.S. producers of bearing parts, components and steel and the erosion of U.S. infrastructure.

TABLE 6--Continued

2. DoD should:
   a. Initiate a time limited FAR for the procurement of domestic bearings for all DoD uses, providing exceptions and waivers within Government's best interest.
   b. Consolidate, coordinate and increase funding for joint service/industry modernization programs for domestic bearing manufacturers.
   c. Investigate DoD capabilities and industry needs for a projection of bearing requirements.
   d. Examine the refurbishment capacity within the commercial industry and determine the appropriate workload split between commercial and in-house DoD.

Source - JBWG

III. CIVILIAN INDUSTRY STUDIES

A. Introduction

As discussed earlier, the scope of the literature survey on foreign dependence included two basic categories of studies or reports: those that focus on industry from a defense production standpoint and studies that deal with U.S. industry from a health and international competitiveness standpoint. The latter deal with the circumstances and causes of foreign dependence. Some industry studies, such as those on shipbuilding, perhaps could be put in either category because of a very direct economic relationship to defense, even in peacetime. However, for purposes of organization, all of the industry specific studies are included on this section, with the obvious exception of the several studies requested by Congress which looked at the industries from a national defense standpoint. Those were the microchip, ferroalloy and bearing studies. Interestingly enough, there were several civilian studies on electronics industries as well as a competitive assessment of the U.S. bearing industry.

To give some appreciation of type of studies reviewed, and their sources, Table 7 provides a short title list of the civilian studies included in the survey.

Table 7

CIVILIAN INDUSTRY STUDIES

General Studies	
- Global Competition - The New Reality	President's Commission on Industrial Competitiveness
- Overview - Competitive Status of U.S. Industry	NRC
- Foreign Industrial Targeting -- Phase I - Japan -- Phase II - Europe -- Phase III - Third World	ITC
- Assessment of Impact of Barter/Countertrade	ITC
Electronic	
- Competitive Assessment Semiconductor Manufacturing Equipment	DOC
- Competitive Assessment - Fiber Optics	DOC
- Competitive Assessment - Software	ITC
- Changes in Telecommunications Industry	ITC
- Competitive Status - Electronics Industry	NRC
Machinery	
- Competitive Assessment - Flexible Manufacturing	DOC
- Competitive Assessment - Manufacturing Automation Equipment	DOC
- Competitive Assessment - Construction Equipment	DOC
- Competitive Assessment - Farm Machinery	DOC
- Competitive Position of U.S. Robotics Producers	ITC

TABLE 7-- Continued

- Competitive Assessment - Metalworking Machine Tools	ITC
- Competitive Status of Machine Tool Industry	NRC
- U.S. Machine Tool Industry and Defense Industrial Base	NRC
Composite Fibers	
- Competitive Assessment - Reinforced Composite Fibers	DOC
- Foreign Industrial Base for Composite Materials	IDA
Petrochemicals	
- Competitive Assessment - Petrochemical Industry	DOC
- Impact of Conventional Energy Rich Nations (CERN) Petrochemical Industry	ITC
- Shift from Commodity Petrochemicals to Specialty Chemicals	ITC
Civil Aviation	
- Competitive Assessment - Civil Aviation Industry	DOC
- Competitive Status - U.S. Civil Aviation Manufacturing Industry	NRC
Shipbuilding	
- Analysis of International Shipbuilding and Repair	ITC
- Shipping and Shipbuilding - Trends and Policy Choices	CBO
- Shipping, Shipyards and Sealift	NACOA

TABLE 7--Continued

Others

- Competitive Assessment - Foundry Industry	ITC
- Auto Industry - Effects of International-ization	ITC
- Competitive Assessment - Advanced Ceramics	DOC
- Competitive Assessment - Ball and Roller Bearings	DOC
- Competitive Status - Steel	NRC
- Competitive Assessment - International Construction Industry	DOC

Legend

CBO - Congressional Budget Office
DOC - Department of Commerce
IDA - Institute of Defense Analysis
ITC - International Trade Commission
NACOA - National Advisory Committee on Oceans and Atmosphere
NRC - National Research Council

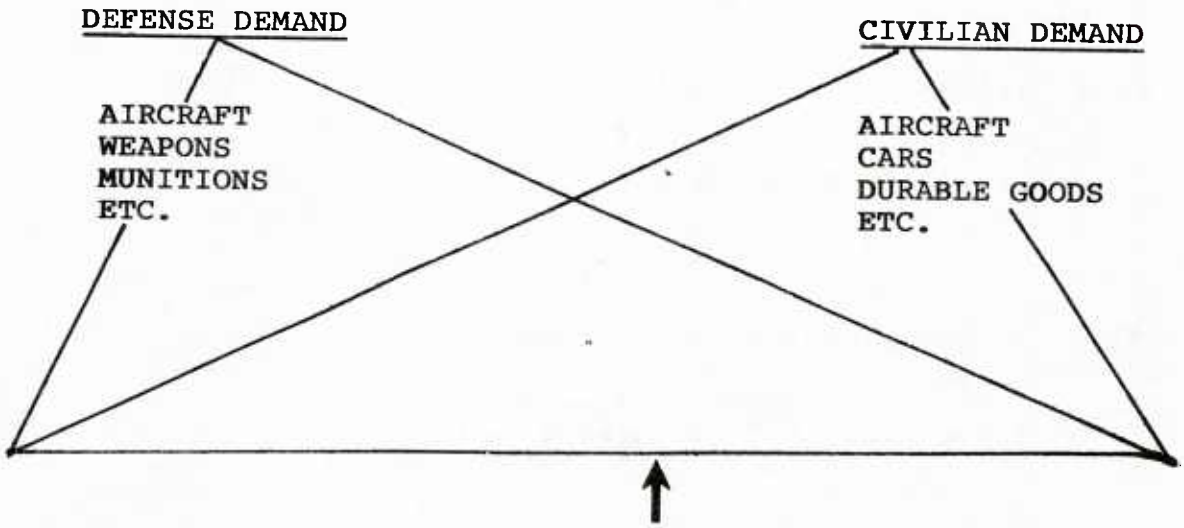
B. Relationship to Defense

The criticality of a healthy civilian industrial base is rooted in the production relationship between the defense industrial base, on the one hand, and the broader national industrial base on the other. Figure 1 visually makes the point that military and civilian demand ultimately draw upon the same industries and basic production inputs such as capital, technology, scientific and skilled manpower, and management. Our national ability to produce weapons rests on the same foundations as our ability to produce industrial and consumer goods. If weaknesses and gaps exist in the subtier and basic industries, such as ferroalloys and bearings, they will inevitably affect our ability to produce military weapons.

In peacetime, foreign dependency is a much less critical problem than in wartime. One could almost say it is not a problem at all, if it were an absolute given that the forces and supplies built in peacetime were adequate to deter aggression against the U.S. and its interests. The worrisome exception is

the emerging possibility of technological dependency, particularly given the criticality of technological superiority to our strategic and conventional deterrent posture.

PRODUCTION RELATIONSHIPS



END PRODUCT - AEROSPACE, ELECTRONICS (E.G. COMPUTERS, TELECOMMUNICATIONS, SOFTWARE), SHIPBUILDING, AUTOMOTIVE, CONSTRUCTION EQUIPMENT, FARM MACHINERY, ETC.

SUBTIER - FORGINGS, CASTINGS, BALL BEARINGS, MACHINE TOOLS, ROBOTICS, SEMICONDUCTORS, SEMICONDUCTOR EQUIPMENT, ETC.

BASIC - STEEL, PETROCHEMICALS, METALS, (E.G. ALUMINUM, TITANIUM, COPPER, MINING), CERAMICS, COMPOSITE FIBERS, OPTICS, ETC.

INPUTS - RAW MATERIAL, ENERGY, CAPITAL, TECHNOLOGY, SCIENTIFIC/SKILLED MANPOWER, MANAGEMENT.

FIGURE 1

Foreign dependence becomes a far more troublesome problem when one considers warfighting. In an absolute sense, deterrence and warfighting are inextricably intertwined. Deterrence provided by standing forces will be much less credible if not backed by a realistic warfighting capability. The key to warfighting, in any type of extended conflict, is a balanced combination of war reserve stocks and industrial capability. Historically, this has included the U.S. mobilization base.

C. Status of U.S. Industry

General

Global Competition - The New Reality, published in January, 1985, is the report of the President's Commission on Industrial Competitiveness. It is a coherent, tightly reasoned and disturbing description of the condition of the U.S. industrial base and the fundamental causes of its growing inability to compete in the international market place. Much of the organization of the balance of this report is drawn from Global Competition.

The U.S. no longer is a domestic economy. The environment in which American business operates has changed dramatically since World War II and the halcyon days of the 40's and 50's. The U.S. is part of an international economy which is growing increasingly interdependent. Almost 20 percent of our production is exported and 70 percent of the goods produced in the U.S. must compete with foreign products in our domestic market. International trade is growing faster than the U.S. economy and represents a vast opportunity, but also a challenge.

The major competitors of the U.S. are Japan and the newly industrialized countries of the Pacific Rim - Taiwan, South Korea, Singapore, Hong Kong and Malaysia. The U.S. has more trade with these countries than with all of Europe combined, and it continues to grow. The Asian countries are taking advantage of the mobility of technology and are aggressively applying it in the manufacture of high quality, low price consumer products. These countries have nurtured their industries through supportive governmental policies thereby changing, in a fundamental way, the rules of competition, hence "The New Reality."

At the same time that a new group of world competitors has emerged in the market place, the U.S. has become increasingly non-competitive within the world market and within its own borders. There are many manifestations of declining U.S. competitiveness.

One indicator is productivity. Since 1960, the U.S. has had a very poor record, experiencing worse growth than all of our major trading partners, to include England. From 1960 to 1983,

the U.S. productivity growth rate was only 1.2 percent. During the same time, Japan's growth rate was 5.9 percent, Korea's was 5.3 percent, West Germany's was 3.4 percent, France's was 3.7 percent, and England had a growth rate of 2.3 percent. The U.S. created 33 million jobs during this time period while Europe had a net loss. The new jobs, however, have been created without investments in productivity enhancing tools and incentives required to provide a competitive advantage to our work force.

At the same time, the standard of living of the U.S. has grown more slowly than much of the rest of the world. Real hourly compensation has been stagnant since 1973 and has actually declined since 1979. Real rates of return on manufacturing have declined over the last 20 years, creating a strong disincentive for investors to put funds into the manufacturing base.

Trade balances have been a growing problem. Global Competition notes that the U.S. has had a negative trade balance since 1975. For the entire century prior to 1971, the U.S. had a positive balance of trade. Last year's trade deficit was a record $148.5 billion. Figures released in July 1986 show the U.S. on a track to a trade deficit of $170 billion for 1986. The U.S. has lost world market share in all types of industries, not just smokestack. Since 1965, the U.S. has lost market share in 7 of 10 high technology industries that are increasingly important in today's markets. Only agricultural chemicals and office equipment grew in market share, while aircraft and parts stayed even. Many observers hold that the problem was simply the overvalued dollar, ignoring the fact that the negative balances started during periods of a weak dollar. The President's Commission believed that the problems of the trade deficit are far more fundamental than the dollar and that a weaker dollar will not solve the problem. That view seems to be supported by the growing trade deficit, notwithstanding a very substantial devaluation over the last year against the yen and European currencies. Part of the problem is that the dollar has not declined against many important trading partners such as Canada, South Korea and Taiwan.

Industry Status

The following discussion will present a summarized status of specific industries important to national defense, either as direct producers of military goods or as convertible capacity in a mobilization. Each industry will be measured in terms of capacity, technology, competitiveness and interdependence, and in terms of whether strong or growing ↑, weak or declining ↓ or holding own/no factor —. Capacity is self explanatory. Technology and competitiveness measure the industry's status compared to the rest of the world. For example, by many measures of industrial health, e.g., R&D expenditures and capital invest-

ments, the semiconductor industry is doing much better than much of American manufacturing. However, because of the extreme competitive pressure from Japan, the industry is losing competitiveness. The fourth measure, interdependence, essentially refers to the industry's ability to produce within domestic resources. In effect, interdependence is a measure of foreign dependence within each industry. Ideally, from a military standpoint, one would like to see up arrows for capacity, technology and competitiveness and a dash for interdependence.

Civil Aviation

Capacity	Technology	Competitiveness	Interdependence
—	↑	↑	—

The civil aviation industry is made up of producers of large transports (Boeing, McDonnel-Douglas, Lockheed), general aviation (Cessna, Beech, Gates, Gulfstream, Piper) and helicopters (McDonnel-Douglas, Bell, Sikorsky, Boeing-Vertol). In addition to these prime contractors, there is an extensive network of engine manufacturers (of which General Electric and Pratt and Whitney are the largest), avionics producers and systems/components suppliers.

The industry is characterized by a high degree of concentration, very close relations and interdependence between the primes and their suppliers and customers, low volume, high value, a dependence on export markets for a significant portion of production and significant military as well as civilian production.

The civil aviation industry, because it supports a large aerospace industrial base that is readily convertible to military production, is critical to national defense. Because of the high value of its products and its positive trade balance, it is similarly important to the economy.

While capacity is stable, the industry leads the world in its technology and its competitive posture. Although the European community and Japan have targeted civil aviation, no serious competitive inroads have been made to date, except in commuter aircraft. Europe is committed to supporting a civil aviation industry, to the extent of subsidizing losses in the past.

There has been substantial pressure for technology transfer, coproduction and offsets as a condition of sales to foreign countries, which could create problems for the subcontractor base in the long run. But the indication is that the industry is exercising great restraint and, in its opinion, is not giving

away the store.

The major competitive problem is the huge costs associated with fielding new transport aircraft. With development costs as high as $3 Billion, new starts are becoming a situation of "betting the company." The risk is high and growing.

Electronics Industry

Semiconductors

Capacity ↓ Technology ↓ Competitiveness ↓ Interdependence ↑

As has already been discussed in some detail, the U.S. merchant semiconductor industry is threatened, some believe to the extent that it will not exist in anything approaching its present form within five years. The captive industry, principally IBM and AT&T, are doing better but a concern is that they will be unable to remain competitive themselves without a healthy merchant industry.

The indicators for the semiconductor industry are all bad. Capacity has been lost, particularly for memory devices such as DRAM's for which the U.S. has substantially withdrawn. The U.S. lags behind the Japanese in a variety of emerging technologies, particularly those based on gallium arsenide. The loss of competitiveness has been such that the industry, with the Administration's support, has been seeking trade relief. On 31 July 1986, the U.S. and Japan announced an agreement which is to open the Japanese market to sales by U.S. chip makers, while bringing to a halt the dumping of Japanese chips at below fair market value .

Finally, the industry has become extremely interdependent, Most U.S. integrated circuits are assembled and tested offshore, mostly in the Far East. In a number of critical supplier areas, including gallium arsenide crystals, glass photo mask blanks and packaging materials, U.S. industry is foreign source dependent.

Participants in the Defense Science Board (DSB) believed that action will be required by the U.S. Government if the semiconductor industry is to remain competitive and capable of providing devices of advanced technology to the military. It is expected that the DSB and NSC efforts will identify fundamental changes and programs that will provide some potential for fixing the problem.

Semiconductor Equipment Industry

Capacity	Technology	Competitiveness	Interdependence
↓	↓	↓	—

The semiconductor equipment industry provides the machine tools of the semiconductor industry. It has historically provided much of the basis for the past technological development and leadership of the semiconductor industry. And, like the semiconductor industry, it has fallen on hard, perhaps fatal times for certain segments.

The section in defense studies dealing with technology has identified the serious loss of technological leadership in manufacturing methodologies. This is, in effect, the baseline technology of the semiconductor industry. In addition to a loss of technological leadership, the industry has also had a substantial loss of market share.

Most of the loss of market share has been to Japanese firms. The reasons for erosion are several. An industry shift from revolutionary to incremental innovation helped the Japanese to catch up. The Japanese initially focused on assembly and packaging equipment as part of their strategy to retain the back end operation at home, unlike U.S. semiconductor producers. The Japanese subsequently caught up in front end wafer processing, aided in part by technology transfers from U.S. firms through joint ventures. The major factor was the massive R&D effort in the late 70's on very large scale integration (VLSI), which had the direct support and guidance of the Japanese government. In the process, the Japanese have produced superior equipment, and have apparently exceeded U.S. equipment manufacturers in three critical standards: reliability, service, and stability.

Computers

Capacity	Technology	Competitiveness	Interdependence
↑	↑	↑	↑

The U.S. computer industry leads the world in sales and technology and has been one of the most remarkable growth industries of all time. Between 1972 and 1981, the U.S. industry had a compound annual growth rate of 18.8 percent. The competitive strength of the U.S. industry is reflected in its dominance of its domestic market while also leading the world market. The success of the U.S. has made computers the subject of targeting by a number of countries, to include Japan. In the case of Brazil, the government has nurtured its computer industry by sheltering it from foreign competition.

The basis for competition is shifting away from hardware, with its focus on quality, reliability, supporting services and price, to software. IBM, for example, is increasingly moving into software support as a major competitive advantage.

Notwithstanding the basic health of the industry, there is a significant degree of interdependence, in terms of semiconductors used in the equipment and peripherals. Many electromechanical peripheral devices such as printers, display terminals and disk memory storage devices are presently foreign sourced. IBM has made some moves to reduce foreign dependence in items such as printers through automation but they may be unique in this regard.

Software

Capacity	Technology	Competitiveness	Interdependence
↑	↑	↑	—

The U.S. software industry is virtually the only high technology industry for which U.S. leadership has not eroded. In 1983, the U.S. held 70 percent of the world market, more than 10 times more than France and Japan, the closest competition. The U.S. competitive position is based on the country's leadership in computers, the innovative and entrepreneurial nature of the industry and the size, homogeneity and sophistication of the U.S. market. It is expected that future competition will come from Japan, who is focusing on the development of software engineering techniques and tools. This contrasts with the U.S. "creative" approach to software development. In addition to attempts to develop software methods, the Japanese are working to downgrade intellectual property protection. MITI has put forward a proposal which would allow the Japanese to require compulsory licensing of software, if in the national interest.

Notwithstanding the current health of the industry, its long term leadership is not assured. Beyond 1987, uncertainties are caused by the fast-paced growth and evolution of the industry, the close linkage with the computer hardware industry and the potential effects of U.S. and foreign government policies.

Supercomputers

Capacity	Technology	Competitiveness	Interdependence
—	—	—	↑

The story of the supercomputer industry is essentially that

of a few relatively small firms, such as Cray, competing with large, vertically integrated Japanese companies such as NEC. U.S. companies have dominated the supercomputer business, with most of the fielded systems being from the U.S.

A problem that bodes ill for the U.S. industry is the fact that the Japanese have targeted supercomputers and are trying very hard to market their products, with some indication of cost cutting to get sales. Because the resources of the Japanese firms far exceed those of the U.S. companies, a significant breakthrough in sales would make it very difficult for firms like Cray, whose only product is supercomputers, to compete.

A second problem is that there's an emerging dependence upon Japanese devices in U.S. supercomputers. Many if the high technology devices are coming from the same Japanese firms which are attempting to compete in supercomputers. There's a growing concern that the Japanese will withhold new chips until they have an opportunity to use them first to their competitive advantage.

Telecommunications

Capacity	Technology	Competitiveness	Interdependence
↑	↑	–	↑

The telecommunications industry is in transition due to the breakup of Bell and the opening of the market for products traditionally supplied by the Western Electric Company. The transition to open competition has also created an opportunity for foreign manufacturers. The U.S. producers' share of the domestic market decreased form 97.0 to 89.2 percent from 1979 to 1983. Much of the import penetration has been for consumer premise equipment (CPE), such as cordless telephones, for which 1983 penetration was 18.7 percent of the domestic market. U.S. exports increased 74 percent during the period 1979 to 1983, but accounted for no more than 4 percent of foreign consumption. The ITC projected several potential future market scenarios. In two of the three, higher levels of import penetration are projected, particularly in CPE.

Although the U.S. telecommunications industry leads the world in technology, its ability to grow is ultimately limited by the fact that many of the national markets are closed, particularly in Japan and the European countries.

Fiber Optics

Capacity	Technology	Competitiveness	Interdependence
↑	↑	↑	—

Fiber optics technology is based on the ability to transmit information by pulses of light through glass fibers. Fiber optics systems are not subject to electromagnetic interference that can effect electrical systems, microwave and satellites. The current applications are dominated by telecommunications and military systems. An emerging, perhaps revolutionary, application is in computer chips which would be millions of times faster than current silicon semiconductors.

The U.S. is the present leader in technology, production and applications, principally due to patents and the size of the domestic market. Japan is mounting a challenge, and has made fiber optics a targeted industry while protecting their domestic market. Europe has substantially closed their market as well.

The future health of U.S. industries will be driven by market shares. High volume is required to generate the resources to finance continuing R & D. U.S. government support is required to gain access to foreign markets and to promote exports.

Consumer Electronics

Capacity	Technology	Competitiveness	Interdependence
↓	↓	↓	↑

Not much needs to be said about the U.S. consumer electronics industry. The U.S. makes no consumer radios, audio tape recorders or video cassette recorders. Imported in finished form are television sets, audio and video tape recorders, radios, high fidelity components and loud speakers. Also imported are color receiver printed circuit boards which are assembled in the U.S. in cabinets. The Japanese produce in Japan; U.S. manufacturers produce in Mexico and the Far East for U.S. assembly.

Shipbuilding

Capacity	Technology	Competitiveness	Interdependence
↓	—	↓	↑

Notwithstanding the fact that the U.S. shipbuilding industry is fundamentally non-competitive vis-a-vis the rest of the free world's shipyards, the U.S. has the largest shipbuilding and

repair industrial base in the Western World. But, of 275 establishments involved in shipbuilding and repair in 1982, only 27 were considered major centers. By 1984, the number had declined to 24.

Because U.S. built commercial ships take twice as long and cost twice as much as comparable foreign ships, the U.S. shipbuilding industry has not built any merchant ships for non-U.S., non-subsidized customers in over 20 years. Consequently, construction and repair of military ships and vessels used in domestic commerce comprise most of the workload. As the commercial shipbuilding base has declined, so has the U.S. supplier base. During the period 1979-84, major components brought from foreign sources totaled $50.5 million.

The U.S. has fundamental competitive disadvantages in the cost of raw and semifinished materials, the cost and availability of capital and the cost of labor. U.S. industry is also at a disadvantage in terms of government assistance afforded most of their foreign competitors.

According to an ITC report, government and industry analysts have asserted that the U.S. does not have a comprehensive maritime policy that deals effectively and equitably with the shipbuilding and shipping sectors while concurrently addressing the need of maintaining national defense capabilities.

Automotive

Capacity	Technology	Competitiveness	Interdependence
↓	-	↓	↑

The principal point to understand about the automotive industry is that it is becoming increasingly internationalized, with U.S. producers outsourcing product lines and components such as drive trains. This phenomenon is not limited to the U.S. industry but is true of Europe as well. The Japanese, however, do not purchase foreign components for their cars, except for Japanese cars manufactured in the United States.

Government policies have contributed to this situation, principally the U.S.-Canadian Automotive Agreement which increased automotive trade across the border; the Japanese Voluntary Restraint Agreements; and the Mexican Automotive Decrees which virtually eliminated the importation of finished vehicles into Mexico and increased Mexican exports of engines, transmissions, etc., to the United States.

Without getting into the details of the causes of the

problem, the U.S. since 1979 has lost capacity and competitiveness, principally because of the extreme competitiveness of Japanese products. As the situation evolves, other nations, particularly Korea and Yugoslavia, are capturing market share in the lower end.

The lost capacity and increased outsourcing has had a very serious impact on the subcontractor structure of the automotive industry, to include basic industries such as steel, forging and castings. It is this ripple effect that carries the long term implications for national security.

Construction Equipment

Capacity	Technology	Competitiveness	Interdependence
↓	–	↓	↑

The U.S. construction equipment industry, which has a strong potential for production of weapons in an emergency, is undergoing a downsizing and elimination of capacity. This is due to a worldwide demand recession for construction equipment, coupled with an overcapacity. The demand recession has been caused by reductions in building construction, public works programs, and in surface mining. Exports have been down because of decreased foreign demand and the high value of the dollar. Foreign demand has been driven down by the debt problems of the developing countries and the instability of oil prices. A specific issue that has caused significant economic problems was the 1979 trade embargo imposed on the USSR because of Afghanistan, tightened in 1981 due to the suppression of civil rights in Poland. Caterpillar lost about $500 million in sales of gas pipelaying equipment to Komotsu.

To maintain market share, U.S. producers are going offshore to obtain components and materials, and, in some cases, product lines. Again, there is a very significant ripple effect into U.S. basic industry.

Machine Tools

Capacity	Technology	Competitiveness	Interdependence
↓	–	↓	↑

The U.S. machine tool industry has been under extreme pressure from foreign competition for a number of years, culminating in an industry petition for import relief under Section

232 of the Trade Expansion Act of 1962. The 232 petition was submitted on 10 March 1983 by the National Machine Tool Builders' Association. On 20 May 1986, in response to the petition, the President announced that he would seek Voluntary Restraint Agreements on machine tool imports from Taiwan, West Germany, Japan, and Switzerland for several types of computer and non-computer controlled equipment. In addition, an Action Plan was announced which, among other things, would integrate U.S. machine tool manufacturers more readily into the defense procurement process; modernize machine tool capabilities that support national defense; and provide up to $5 million annually to support a machine tool technology center.

For 1985, import penetration of the U.S. market had risen to 38 percent overall, 48.4 percent of all numerically controlled (NC) machinery, with some types of NC equipment exceeding 50 percent. The cumulative effort of import penetration, which has grown each year since 1973, has been a significant restructuring of the U.S. industry. Capacity has been closed, much of it permanently. To compete with the lower prices of foreign machinery, there has been substantial outsourcing of product line and component parts. Judgementally, it would seem that the real issue is whether the announced trade remedies will be adequate to allow the restoration of a healthy industry. Much of the restructuring and changed business practices can be assumed to be permanent.

Flexible Manufacturing Systems

Capacity	Technology	Competitiveness	Interdependence
—	—	↓	↑

The flexible manufacturing systems (FMS) industry is the key to the factory of the future, the largely unmanned, highly sophisticated, highly flexible manufacturing facilities which may be the answer to U.S. long term competitiveness. FMS involves the integration of the machine tool, material handling, and computer industries. The weak points, from a U.S. stand- point, are machine tools and robotics; the strong point is computers and computer software. The U.S. is presently ahead in large sophisticated units with some indication that the Japanese are leading in mid-sized and small FMS units.

Notwithstanding an agreement that U.S. equipment is superior, the U.S. suppliers are perceived as becoming less competitive due to less service and responsiveness to suppliers; less hands on experience than the Japanese; and more aggressive R & D efforts by foreign firms.

According to a DOC study, the key issue affecting the future of the U.S. FMS industry is the speed and extent to which U.S. manufacturers move to automate their factories. The best situation will be moderate to rapid demand growth over the next 5-7 years, thereby allowing U.S. producers to move down the learning curve more rapidly than foreign importers. To some extent, the U.S. Government can influence FMS growth. It should be noted that the FMS industry is in better shape than its component parts, particularly machine tools.

Ball and Roller Bearing Industry

Capacity	Technology	Competitiveness	Interdependence
↓	—	↓	↑

Ball and roller bearings are fundamental components of all machinery containing rotary parts. They are essential components of most military products and critical in all defense programs. U.S. capacity to make bearings is dwindling due to import penetration, with the causes of decline being lower foreign wage and materials costs. As an indication of the complexities of the foreign dependency issue, the U.S. bearing industry uses foreign steel to keep its prices as competitive as possible. Trade actions to help the steel industry would tend to hurt the bearing industry.

The U.S. remains equal or slightly ahead of its world competitors in bearing technology. This is not a significant advantage because most bearings are produced to international standards and are interchangeable in world markets.

The national security impact of the declining bearing industry were covered in detail in the Defense Studies section of this report, based upon a JLC study published in June 1986.

Castings

Capacity	Technology	Competitiveness	Interdependence
↓	—	↓	—

The U.S. foundry industry encompasses some 3400 foundries, which manufacture castings composed of iron, steel, and many nonferrous metals. Castings are used in 90 percent of all manufactured goods and in all capital goods machinery used in manufacturing. The industry suffered a significant downturn from 1979 to 1983. Shipments were down 38 percent, sales down 21 percent, employment down 40 percent, and profits fell from $1.6 billion in 1979 to a $527 million loss in 1983.

The basic cause of the decline is the industry has not been cost competitive with foreign producers, in terms of labor, capital, exchange rate, cost of tooling and patterns, and government regulations affecting cost. Other causes of competitive disadvantage include foreign government assistance, tariff and non-tariff barriers to U.S. exports and foreign government regulations such as domestic content requirements.

In addition, to competitive disadvantages which have led to outsourcing by U.S. manufacturers, the industry is further beset by loss of market share by other U.S. manufacturers, such as automobiles and machine tools. The casting industry situation is an illustrative example of the ripple effect of loss of market share by U.S. manufacturing.

Steel

Capacity	Technology	Competitiveness	Interdependence
↓	↓	↓	—

The importance of a steel industry to the economy and national security is universally accepted. However, since 1980, the industry suffered severe losses in raw steelmaking capacity, in employment and in net income. Capacity has fallen from 154 million tons of annual capacity to 130 million tons estimated for 1986. Employment has fallen from 400,000 workers to less than 225,000 in 1985. The industry has not made a net profit since 1981, losing in excess of $1.5 billion in 1985. The imports share of the domestic market has risen from a little over 16 percent in 1980 to about 27 percent in 1985, with an expected decline to 26 percent in 1986.

The industry is made up of two main groups, each having two important subdivisions. The main groups are integrated producers and non-integrated producers or minimills. The former start with iron ore, coal and limestone and have total front to back facilities. Minimills start with scrap as the primary raw material and represent 20 percent of the total U.S. capacity. The subdivisions are carbon steel and specialty steel. In general, the minimills and specialty steel producers have fared better than the large producers of carbon steel.

The U.S. steel industry faces problems of high costs resulting from old facilities, higher labor costs, chronic worldwide overcapacity, strong import competition from countries seeking to penetrate the U.S. market (often at below-cost prices), long depreciation schedules, poor profitability and management problems. It appears inevitable that the industry will shrink and will represent a declining fraction of world capacity.

The real story about steel capacity is not where it is today but where it is likely to end up. Estimates of expected capacity in a 1985 National Research Council study vary from 108 to 115 million tons to as low as 87.5 million tons. The potential significance of these kinds of losses of capacity is contained in the fact that the U.S. fought World War II with a steel capacity of 88 million tons per year. Although the NRC study examined the issue of potential steel requirements in a mobilization, it was unable to arrive at a conclusive number. The real issue, then, is how much is enough?

Ceramics

Capacity	Technology	Competitiveness	Interdependence
↓	—	↓	—

The advanced ceramics industry encompasses two principal businesses: electronic components and engineering products. The U.S. has lost the ceramic packaging industry to the Japanese and will probably lose in the ongoing products arena as well, notwithstanding the fact that neither nation has a clear lead in technology. Japan has made, as a matter of national policy, a commitment to the commercial development of advanced ceramics. They may be expected to win because: (1) they have dominated the electronics components business; (2) they dominate the supply of advanced ceramic powders; (3) they are undertaking a greater and more organized R&D effort; (4) their initial performance is strong in terms of cost characteristics in demonstration products; (5) their ability to take a long-term view and to accept short-term losses; and (6) they have a record in developing and implementing superior commercial manufacturing processes and process technologies.

Japanese dominance will have a tremendous negative impact upon the economy because of the potential ripple effect into automobiles, power generation equipment, machine tools, aircraft and other industries. This lost opportunity will affect future domestic growth, employment and balance of trade performance in the nation.

According to a DOC study, advanced engineering ceramics could substitute for many, if not most, of the strategic materials considered in short supply and being held in the national strategic stockpile. If the U.S. competitive position plays as predicted in the DOC study, the cost to DoD of independently pursuing military dedicated ceramic programs and supplies will be much higher and harder to achieve.

Composite Fibers

Capacity	Technology	Competitiveness	Interdependence
↑	↑	↑	↑

Carbon and aramid fibers, the latter principally used in tires, are increasingly being used in advanced composite materials. Carbon fibers, when imbedded in a polymer, improve the strength, stiffness or durability of the composite material. They now have some military applications, particularly aerospace, and have the potential for use in future hardware items such as rocket launchers, portable bridges, and others.

The U.S. is the leading producer of composite reinforced materials but is dependent upon imports for raw materials. PAN, a precursor material, is imported from Great Britain and Japan. Quartz fiber is imported from France, and the hardener for curing epoxy resins and quartz fibers is also available only from France. DoD has taken action to induce the expansion of the U.S. base for production of PAN.

The composite industry is an example of a healthy industry which is very interdependent.

Ripple Effect of Import Penetration

A number of the descriptions of individual industries have alluded to a ripple effect into subtier industries. Table 8 below, from Business Week and based on Data Resources Inc. data, gives a specific example of the effects of imports.

D. Causes of Competitive Decline

As noted at the beginning of the section on civilian industry and evidenced in the title list at Table 7, there have been many studies which have addressed the international competitiveness of U.S. industry. Individual industry studies generally address the specific condition and unique circumstances of each industry's competitive posture. The task of writing a coherent summary of the causes of U.S. industry's competitive decline is made much simpler by the existence of Global Competition - The New Reality, which, among other things, identifies the fundamental causes of U.S. decline. The four principal determinants of competitiveness identified are technology, capital resources, human resources and trade environment. Each of these determinants will be discussed in turn.

Table 8

COST TO THE ECONOMY OF

IMPORTED CARS

For each $1 Billion of foreign automobiles imported, the U.S. economy loses:

$1.2 BILLION	in auto production, includes $200 million of vehicles to haul raw materials in and finished autos out.
$778 MILLION	in manufacturing, including: $184 million in steel and fabricated metal parts $ 98 million in machine tools $ 67 million in rubber and plastics $ 46 million in nonferrous metals $ 40 million in chemicals
$348 MILLION	in wholesale and retail margins, transportation, warehousing, and utilities
$ 47 MILLION	in mining
$ 39 MILLION	in financing and insurance
$ 16 MILLION	in plant construction
$2.43 BILLION	TOTAL COST TO THE U.S. ECONOMY

Technology

U.S. technological preeminence over the years has been the basis for much of the standard of living enjoyed by Americans. It has historically been our strongest competitive advantage and has caused the creation of whole new industries. Three basic things are required to make technology a continuing competitive advantage: (1) the creation of a solid foundation of science and technology relevant to commercial uses; (2) the application of new science and technology to commercial products and processes; and (3) the protection of intellectual property rights through the strengthening of patent, copy right, trademark and trade secret protections.

Regarding the creation of innovative technology, the issue is not the amount of national R&D expenditures but its focus. In absolute terms, the U.S. spends more on R&D than Japan, France and Germany combined. In terms of percentage of GNP, the U.S.

spends more than any of our competitors. The problem, from a competitiveness standpoint, is that the focus of much of the R&D is on defense and space programs which do not have commercial application as a prime objective. About half of the total U.S. R&D dollars are funded by the Federal Government and about two-thirds of that is spent on defense and space. In terms of commercially relevant R&D which directly affects industrial competitiveness, the U.S. spends less than either Japan or Germany. Both spent over 2.4% of GNP on commercial R&D in 1982 vs a U.S. expenditure of about 1.8% in 1982 through 1984.

According to the President's Commission, another aspect of the problem of Government R&D, in addition to the lack of a competitiveness goal, is the lack of common management. There are more than 700 Federal laboratories which employ one sixth of the country's scientists and engineers. Each research entity has an independent mission. Many have overlapping and sometimes obsolete charters.

The Government also funds and performs much of the basic research of the country. Because of its high-risk nature and the uncertainty of being able to limit competitive benefit to those funding the research, there is little incentive for private firms to invest in basic research. Since basic research is the absolute foundation for technological advancement, this is a problem that must be dealt with.

A shortage of engineers exists in the United States. The impact is particularly felt in the universities which, due to an inability to compete with industry in terms of salaries, have a 10% vacancy in their engineering faculties. Therefore, their ability to train new engineers is diminished. Japan currently graduates more engineers annually than the U.S. in absolute terms (73,600 vs 67,400 in 1982) and far more in terms of population (62 per 100,000 persons vs 29 per 100,000 in the U.S.). The problem is further exacerbated by the fact that 55% of the engineering doctorates awarded in U.S. universities in 1984 went to foreign citizens.

The most glaring deficiency in the area of technology is the failure of the U.S. to devote enough attention to the application of technology to its manufacturing processes. Robotics, automation and statistical quality control are examples of U.S. developed technologies which have been more effectively applied by our competitors. The result, particularly for the Japanese has been the ability to manufacture lower cost and superior quality products which have been highly competitive in U.S. markets.

A key element in incentivizing increased R&D by private firms is improved protection of intellectual property. America's comparative advantage in high technology industry, as well as more mundane items such as clothing and books, has been seriously

weakened by commercial counterfeiting, copyright and design infringement, technology pirating and erosions of intellectual property rights. The ITC has estimated that the U.S. loses almost $8 billion and 131,000 jobs annually solely to counterfeiting abroad. An example of potential erosion of intellectual property rights is the software industry, mentioned earlier, in which the Japanese government is attempting to downgrade the protection afforded to software.

Finally, the President's Commission noted the fact that regulatory restraints inhibit innovation and commercialization. The U.S. has a cumbersome and complex regulatory environment which has the effect of allowing the introduction of innovative products more easily and quickly abroad. The issue is not whether regulations should exist. The problem is that overlapping regulatory charters and jurisdictional disputes, combined with rigid, time-consuming requirements, have seriously discouraged the introduction of innovative products. Pharmaceuticals are mentioned as a particular problem, with the time and cost to bring each new product to market averaging 10 years and $84 million. Although pharmaceuticals were not specifically addressed in the earlier section, a healthy pharmaceutical industry would be essential in the treatment of casualties in a future conflict.

Capital

Capital, money put to work, is the fuel of the economy. It provides the productive assets, plant and equipment, required to compete. It provides the R&D required to obtain technological advancements critical to competitiveness. It provides the ability for entrepreneurs to bring new ideas and products to the market. The availability and creative use of capital is critical to a competitive position. The U.S. lag in productivity growth rate is correlated to its investment rate. The U.S. trails its major competitors in both areas. There are three problems regarding capital in the U.S.: supply, cost, and flow to the most productive uses.

The supply of capital in the U.S. is inadequate. The first cause of this problem is the fact that the U.S. savings rate is much lower than that of our foreign competitors. Because the U.S. tax system discourages savings and encourages borrowing, the U.S. savings rate as a percent of gross domestic product was about 7% in 1982. This compares to a Japanese savings rate of about 18% and a French rate of around 12% in the same year.

The second cause of the problem of inadequate capital supply is the deficit. The Government has first call on capital and, in this era of large sustained deficits, bids capital away from private industry. This circumstance has been mitigated by the influx of foreign capital, which cannot be counted upon to

continue indefinitely. The Commission noted two other pressures of Federal deficits. First, they encourage increased taxes, usually without regard to competitive effects. Second, they place pressure on the Federal Reserve System to create more money by buying up some of the debt, thereby pushing up inflation.

Global Competition notes that the cost of capital to U.S. firms is much higher than for their foreign competitors; in the case of Japan, twice as high. This is caused by the Government competition for funds and the tax bias against investment mentioned above. Another factor is the greater reliance upon equity (stock) financing by U.S. firms. The effect of a lower cost of capital for Japan is a major competitive disadvantage for U.S. producers. Japanese competitors have been able to invest more heavily in new technologies and processes, thereby improving productivity and cost competitiveness.

The flow of capital is distorted by tax and regulatory policies, which exacerbates the problems of availability and cost just discussed. Tax laws have discouraged savings by taxing interest earned but encourage borrowing by exempting interest payments. Corporate income is taxed twice, as profits and dividends and by capital gains in stocks, while interest on state and municipal bonds are exempt from taxation. The difference between tax rates within industry may have a greater competitive consequence than the overall level of taxation. The Commission noted that industry tax rates do not consider competitiveness.The manufacturing segment had the highest marginal tax rate of all U.S. industry. Manufacturing is taxed at 46%, wholesale and retail industry at 30% and all other industry at 11%.

The tax reform package pending in Congress will clearly modify the effects discussed above. A general observation, not based upon a substantive review of tax reform, is that the lower rates proposed for individual tax payers will largely be financed by a transfer of taxes to corporate America, with no clear indication of its effects upon industrial investment.

Human Resources

The human resource problems associated with international competitiveness are indicated by four essential tasks: (1) the need to reach a national consensus regarding the world challenge, (2) the need for improved cooperation between management and labor; (3) the acquisition of an ability to redeploy our workforce in response to new technology and markets; and (4) the need to strengthen the quality of our human resources.

The President's Commission noted that the need to reach a national consensus on industrial competitiveness is acute. Competitiveness issues are unresolved, notwithstanding their existence for some time. During 1983, 60 advisory committees

associated with the U.S. Trade Representative, and the Departments of Commerce, Labor and Treasury dealt with issues affecting U.S. competitiveness in world markets. The effect of those committees (and, one could argue, the President's Commission on Industrial Competitiveness) was very little. The political decisionmaking process has not been able to deal with the conflict between the various sectors and the widely disparate views of the various interested parties.

The historic adversarial relationship between management and labor no longer serves the interests of the parties involved or the nation as a whole. Foreign competitiveness, coupled with slow growth and the advent of new technology, requires more cooperation at home. Notwithstanding improvement of relations in some embattled industries, a survey revealed that only 9% of American workers felt that they would benefit directly from improved productivity whereas 93% of Japanese workers felt productivity would benefit them directly. Labor and management must recognize their common interests.

Regarding redeployment, the work force needs help adapting to change in the work place. No adequate programs exist to help displaced workers from declining industries acquire new skills and find reemployment. Beyond the issue of the displaced unemployed is the broader issue of the changing workplace in the future. The constant introduction of new technology makes it essential that people continue to learn all their lives, to enable them to make productive contributions as the economy changes over time.

This need for continuing, forward looking training is not being provided by employers, who are the primary suppliers of formal training and retraining for most workers. Training expenditures, given labor mobility and the demand of short-term profitability, are hard to justify for individual firms. Therefore, industry essentially lacks the incentives to provide the level and type of training required to keep the work force productive. Other sources of training - community colleges and vocational schools - have only a limited ability to help industry due to a lack of funding and a lack of communication regarding industry's ever evolving skill needs.

The quality of our human resources ultimately hinges upon the quality of our education system. The universities suffer from inadequate staffing noted earlier, inadequate funding and obsolete classroom equipment. The Commission endorsed the call for improvements in elementary and secondary education made by other reports and noted two specific areas of concern. One was the 26% dropout rate in American high schools which brings over 1 million untrained, inadequate entrants into the work force each year. The second is the national failure to effectively use technology to enhance education.

U.S. Trade Environment

Trade has become increasingly important to the future of American industry. World trade is $2 trillion and is growing faster than the U.S. economy. U.S. exports quintupled between 1970 and 1984, currently exceed $220 billion annually and provide jobs for 5 million Americans. Exports in 1984 represented about 21% of U.S. manufacturing output. On the other hand the value of merchandise imports approximate almost 25% of U.S. industrial production.

Effective competition in world markets requires the U.S. to: (1) articulate and enforce a coordinated national trade policy; (2) reduce domestic obstacles to U.S. trade; (3) balance foreign policy and national security export controls with trade needs; (4) expand exports; and, (5) work to strengthen the international trading system.

Trade is not a national priority for the U.S. but it is in most other countries with which the U.S. trades. The unequal stature of trade and international economic policies is symptomatic of the high degree of fragmentation in the policymaking process. Decisions are presently split between 25 executive branch agencies and 19 congressional subcommittees. The Departments of State, Justice, Treasury and Defense make policies that affect the U.S. trade position, often without consideration of their impact upon U.S. competitiveness. Two Cabinet level committees consider trade policy - the Trade Policy Committee and the Cabinet Council on Commerce and Trade. The former is chaired by the U.S. Trade Representative (USTR) and the latter by the Secretary of Commerce, who are responsible for formulating trade policy and implementing it respectively. Neither of the committees has the authority to consider several international economic issues that directly influence U.S. trade policy effectiveness, i.e., exchange rates, credit, debt and taxation.

U.S. trade policies are not responsive to the new realities of global competition and present serious obstacles to U.S. trade. U.S. trade law has often provided relief to industries threatened by severe import penetration only after their injury has become irreparable. Relief has been provided without plan or hope for recovery or readjustment. "Unfair foreign practice" laws have been ineffective in dealing with the new national strategies of our foreign competitors, which will be discussed later. U.S. antitrust laws are obsolete, dating back to a time in which America was isolated from international competition. The implementation of the laws often fails to give adequate consideration to the fact that U.S. firms no longer operate in a closed economy. Antitrust policy has been slow to recognize the global market, effectively precluding U.S. industry from increasing its ability to compete through rationalization and consolida-

tion.

Global Competition notes that export controls for foreign policy or national security reasons were imposed only 24 times in the 56 years between 1914 and 1970. Since 1970, controls have been imposed on an average of twice a year. The effects of foreign policy controls are estimated to be a loss of $4.7 billion in annual sales. National security controls are estimated to cost another $7.6 billion in annual sales lost. Foreign policy controls rarely achieve their desired goals when imposed unilaterally, such as the restriction upon sales of pipeline equipment to the Soviets, because our trading partners take the sales. Although there is close cooperation with our allies on national security controls, the U.S. often imposes controls beyond those applied by our allies. In those instances of permissable sales, the licensing delays are much longer for U.S. firms than those imposed by our trading partners. The effect of all of the above is lost sales and the creation of the reputation of U.S. industry as an unreliable supplier. It should be noted that some steps have been taken by the Departments of Commerce and Defense to expedite consideration of export licenses, since the Commission's report.

Expanded exports have the potential, according to a GAO report cited by the Commission, of creating 125,000 new American jobs and $4 billion in sales. For this to happen, the President's Commission believes that potential U.S. exporters must receive far more help from the Government than is now the case. The U.S. Export-Import Bank currently finances only 6% of U.S. exports compared to 35% of the exports of Japan and Great Britain receiving similar financing. Relatively few U.S. firms export - the top 250 export firms account for 85% of total exports - due to U.S. trade laws which provide little assistance and many barriers. It is estimated that 11,000 additional firms could export but do not at the present. A barrier for many is the lack of information about foreign markets, information that currently exists within the Government but is not easily available to U.S. firms.

The world trading system, like U.S. trade law which is no longer consistent with the realities of global competition, has not kept pace with the changes in the world market place. The General Agreement on Tariffs and Trade (GATT) provides the only set of comprehensive agreed upon rules for free world trade. The GATT has a number of deficiencies, however. It does not cover trade in services or investment. Its rules regarding agriculture and state owned enterprises are inadequate. GATT does not adequately deal with foreign industrial policies and the emerging use of nontariff measures such as antitrust exemption, R&D subsidies and restrictions on foreign investments. Compounding the problem, particularly as regards U.S. trade with the Pacific Rim, is the fact that the newly industrialized countries (Korea,

Taiwan, etc.) are not subject to the same standards of trade conduct as are the U.S. and other developed countries.

Value of the Dollar

A contributor to the lack of competitiveness of U.S. firms until about a year ago was the overvalued dollar, particularly against the yen. The National Research Council, in its examination of the electronics industry in 1984, noted the periodic and severe misalignments in the dollar-yen exchange rates. The current turnaround had been preceded by a long period of an overvalued dollar and an undervalued yen, which had the effect of reducing the price competitiveness of U.S. goods against Japanese goods by over 50% in the period from 1978 to 1982.

The President's Commission noted the tendency of some to blame the strong U.S. dollar as the main cause of the lack of U.S. competitiveness. This line of reasoning argued that the U.S. would regain lost position once the dollar moved to a lower level. The principal point made by the Commission was that, while a contributor to the problem, the strong dollar was not the sole cause of the loss of U.S. competitiveness and that a weaker dollar would not solve the problem if the other fundamental causes were not addressed. Starting in the fall of 1985, subsequent to the publication of the Commission's report, the dollar has undergone a substantial depreciation against the yen and European currency. Notwithstanding the depreciation and the expectation of a near term decline in the trade deficit, the opposite has happened. The trade deficit has continued to rise, reaching an annual rate of $165 billion. Reasons for the increase, according to Hobert Rowen in a 3 August 1986 Washington Post column, are several. Many foreign firms, particularly Japanese firms attempting to protect market share, are accepting less profit and reducing price. The dollar has not declined against all currencies, particularly against several important trading partners such as Canada, Korea and Taiwan. Another aspect of the failure of the deficit to decline is the fact that the initial effect of the depreciation is to raise the value of the foreign goods already ordered, thereby raising the cost even if the volume is constant. Another reason is the Third World debt crisis which has diminished the ability of developing nations to buy American goods.

The events over the last year would seem to reinforce the view of the Commission, i.e., that a weaker dollar will contribute to U.S. competitiveness but will not solve the problem unless all the fundamental issues are favorably resolved.

Foreign Industrial/Targeting Policies

Much of the preceding discussion of the various causes of U.S. competitive decline has dealt with issues of shortcomings in terms of what the U.S. is doing to respond to foreign competition. Another aspect of the problem, implicit in the emergence of the global economy, is the policies being pursued by our trading partners regarding their industrial competitiveness.

Simply stated, industrial competitiveness is a national policy in many, if not most, of the countries with which the U.S. trades. An element of national industrial policy used by Japan, many European countries and by newly industrialized countries (NIC's) such as Brazil, Korea, Taiwan and others is industrial targeting. The ITC defines industrial targeting as coordinated government actions that direct productive resources to give domestic producers in selected industries a competitive advantage. There are four elements to the definition: (1) targeting is done by governments; (2) productive resources are directed; (3) industrial policies are targeted only when applied to specific industries and not uniformly to all industries; and (4) the government actions provide domestic producers a competitive advantage.

The ITC performed three comprehensive studies on industrial targeting, on Japan, the European Community, and selected other countries including Brazil, Korea and Taiwan. The ITC, while describing the methods used by the various countries, believes that the evidence is inconclusive regarding the claim that targeting helps the general economic welfare of the country using it. The problem in assessing the effectiveness of targeting is the inability to determine what would have happened if targeting had not been pursued. In addition, there is an economic cost to the country using targeting techniques; a benefit to one industry imposes costs on other sectors of the economy.

Notwithstanding the caveat, it is clear that industrial targeting is used, with varying degrees of impact upon the targeted industry and, therefore, upon its ability to compete world-wide. It has clearly worked for some countries, in some industries. For example, the ITC states that industrial targeting has benefited the international competitiveness of the Japanese steel, electronics, machinery and automobile industries. Targeting techniques used by Japan and other countries include home market protection, financial assistance, tax incentives, focused and cooperative R&D and antitrust exemptions.

Home market protection is typically used to exclude imports until the supported industry emerges in a robust form and is capable of competing on its merits. Protection is also used to protect, over the long term, the weakest, least competitive sectors of economies, such as agriculture. Japan used formal

trade restrictions as an important strategy through the mid-1960's. By the early 1970's, Japan had backed its tariffs down to levels comparable to other industrial countries. Japanese government procurement remained substantially closed to foreigners, particularly those of Nippon Telephone and Telegraph (NTT), the Japanese telecommunications monopoly. This issue remains a source of friction, with constant U.S. pressure to open the market in Japan. European use of barriers has generally declined but, when used, tends to be applied to depressed industries such as steel. The NIC's typically protect their infant industries. A good example is Brazil which has protected its automobile, textile, footwear, computer, semiconductor and steel industries as they have grown up. Some countries have used the added technique of excluding foreign ownership. In general, Europe is more open to U.S. investment than the rest of the world.

Financial assistance to targeted industries is commonly used, through mechanisms such as subsidized loans, loan guarantees and grants. Outside of the context of targeting (aid limited to specific industries) but directly supporting industrial competitiveness, the Japanese government explicitly fosters high levels of investment by keeping interest rates low, directing money to the commercial banking system, limiting consumer credit and restricting investment in foreign countries. These policies, coupled with the structure of their capital markets which give the Japanese government the ability to direct large sums of capital to specific sectors, provide the wherewithal to significantly support industrial competitiveness. While European countries provide support to their industries, the effectiveness of Japanese assistance is more measurable, in industries such as electronics.

Tax incentives are used to encourage R&D in countries such as Japan, France, Great Britain and West Germany and to provide special tax treatment for targeted industries. In Japan, the tax code has been recently used to aid computers, robots, machine tools, forging machinery, foundry equipment, and computer-aided design and manufacturing equipment. In addition, different nations use the tax code to encourage purchases from targeted industries through mechanisms such as accelerated depreciation.

Government supported R&D has been an important targeting tool, particularly in Japan where the technique has been used successfully in the shipbuilding, machine tool, computer and semiconductor industries. Cooperative R&D efforts between firms have been encouraged and are not a problem under Japanese law, a situation that has not been the case in the U.S. until recently. The Very Large Scale Integration (VLSI) program is an example of an extremely successful cooperative R&D program supported and funded by the Japanese government. The VLSI program is credited with providing much of the impetus for the very strong competitive position held by the Japanese semiconductor industry. In

Europe, in an attempt to stay current with Japan and the U.S. in information technologies, the European Community has funded a $650 million R&D program called ESPRIT, European Strategic Program for Research and Development in Information Technologies. Individual countries provide funding to internal programs, with the British and West Germans favoring the aircraft and electronic industries.

In contrast to the U.S. competitive problems caused by antitrust legislation, Japanese antitrust law is more permissive and the government is much more likely to give exemptions to the law. These exemptions allow companies to carry out joint actions that would ordinarily be illegal. Cartels are allowed in Japan to support small and medium-sized businesses and to encourage exports. In Europe, the French allow considerable concentration in distressed industries, to the point of encouraging mergers through subsidized loans. Germany, on the other hand, is less likely to give exemptions to its laws involving mergers.

Over the years, the Japanese have engaged in industrial targeting in aircraft and aerospace, automobiles, computers, semiconductors, telecommunications, steel, machine tools, robotics and synthetic fibers, with significant success in most. As an example that targeting does not always work, the Japanese also targeted aluminum, which remains structurally depressed. In Europe, targeted industries have included coal and steel, shipbuilding, textiles, apparel, automobiles, aircraft, computers and telecommunications. In general, the Europeans have been much less successful in making their industries competitive than have the Japanese.

The NIC's have typically followed the historical Japanese model by excluding imports until the protected industry is capable. Once competitive, the governments then support exports. Targeted industries have included automobiles, textiles, steel, computers and semiconductors, shipbuilding and machinery. As noted earlier, several of the Pacific Rim countries such as Korea and Taiwan are emerging as very strong competitors to the U.S. and Japan. This can be partly ascribed to the pursuit of industrial targeting.

One of the long-term effects of multiple countries targeting the same industries is a worldwide overcapacity, particularly in mature industries such as steel and shipbuilding. The same situation has arisen in high technology industries as well, such as semiconductors. The implications for U.S. industry are serious, given the other circumstances identified earlier. In the long run, worldwide overcapacity must be rationalized down to a level closer to true demand. If U.S. capacity is less competitive, for whatever reasons, its prospects of survival in a world economy have to be suspect. Steel is a prime example of a U.S. industry that will inevitably undergo shrinkage unless action is

taken to make the industry more competitive.

E. U.S. Industry Reaction

U.S. industry is essentially following a strategy of survival. For many companies that means moving away from a U.S. manufacturing base to one offshore as an easy answer to remain competitive and profitable. BusinessWeek quotes Akio Morita, Chairman, Sony Corporation:

> "America's companies have either shifted output to low-wage countries or come to buy parts and assembled products from countries like Japan that can make quality products at low prices. The result is a hollowing of American industry. The U.S. is abandoning its status as an industrial power."

Another way of describing the above is that there has been the emergence of the hollow corporation in U.S. industry which was the subject of a March 3, 1986 BusinessWeek special report. The logical extreme is the emergence of network corporations which have either substantially abandoned manufacturing or were never manufacturers in the first place. They are industrial companies without industrial production. In effect, network companies are small, central organizations which manage the process of getting a product to market, relying upon others to perform functions such as manufacturing, distribution, marketing, and other crucial business functions. Examples are Nike, which had $1,000 million in 1985 revenue, and 100 of 3500 employees in manufacturing and Emerson Radio with $500 million in revenue and 150 of 700 employees involved in manufacturing.

At the other end of the spectrum are the mainline manufacturers which are increasingly going offshore for solutions to their competitiveness problems. Companies such as Caterpillar, Eastman Kodak and Honeywell have pursued strategies which have included offshore sourcing of parts and materials, outsourcing labor for cheaper assembly (e.g., the back end of semiconductor manufacture) and outsourcing entire product lines. Examples of the latter include small cars in the automotive industry and some product lines in the machine tool and construction equipment industries.

Another aspect of offshore sourcing is the increasing internationalization of R&D and manufacturing through joint ventures. Industries such as commercial aircraft and jet engines, for cost and competitiveness reasons, are increasingly engaging in joint ventures with Japanese and European industry. The potential implications of this are more interdependence, more foreign competition and less domestic capability, particularly in the subtier structure.

The impact of the hollowing of American industry is most severe on subtier industries such as steel and castings. Steel, for example, is losing sales through loss of market share to imported steel and through a reduced total market because of less U.S. manufacture of products containing steel.

The ultimate effect of the hollowing process may be a relatively healthy economy (although there is considerable debate on that issue) with little productive capacity available to support potential defense needs in a conflict.

F. National Policy Options

The solutions to the problem of U.S. industrial competitiveness lie in broad based, fundamental changes in the four major areas discussed above.

Technology

The U.S. must take positive action to create, apply and protect new technology. As a first step, the Commission proposed that a cabinet-level Department of Science and Technology should be created. The purposes of the separate department would be several: to make clear the importance of science and technology as a key to enhanced competitiveness through innovation; to allow effective formulation and pursuit of national technology goals; to improve the interaction of Government, industry and academia; and to provide a high-level adviser to the President on Government policies that affect science, technology and the use of innovative products. The structural elements and funding exist; they simply need to be organized and focused more effectively.

Private industrial R&D should be supported through tax incentives and removal of antitrust barriers to cooperative research. R&D tax credits should be made permanent in lieu of temporary which makes long-range projects difficult to plan. A variety of tax credits should be used, which would be preferable to direct Government funding because they would let the marketplace determine allocation. It should be noted that these proposals were made against the existing tax structure, prior to tax reform. The National Cooperative Research Act of 1984 provided some clarification of the antitrust implication of joint R&D efforts but industry apparently believes that clearer policy is required to allow unfettered cooperation.

The Commission called for increased Government support to universities for basic research and the training of future scientists and engineers. Funds currently allocated to Federal laboratories could be freed up and made available to the universities through improved management. Money sent to the universi-

ties would be better spent in that it would have a dual purpose, scientific advancement and the training of future scientists and engineers.

Manufacturing technology should be promoted through expanded application of the R&D tax credit and increased industry investment. Universities need to improve the quality and quantity of manufacturing-related curriculums. Government funding for research should include process technologies. DoD and NASA should make special efforts to transfer Government developed manufacturing technology to the private sector for commercial application.

The Commission believed that the Government must launch a major policy effort to strengthen the protection of intellectual property rights at home and abroad. Even small changes which cumulatively add up to better protection, should be pursued. International protection should especially be strengthened through negotiations on treaties, tariffs and trade. Patent laws should be streamlined. Measures should also be taken to protect the confidentiality of private scientific information held by the Government from release under the Freedom of Information Act.

Finally, the legitimate goals of regulation should be balanced with the need to bring the results of innovation to the market through a rigorous examination of how regulations and regulatory agencies affect the U.S. ability to innovate.

Capital Resources

According to the Commission, the cost of capital to American industry must be reduced. The first action that must be taken is to reduce the deficit to increase supply. To reduce the deficit, emphasis must be given to steady, non-inflationary economic growth and strictly curbing the growth of Government spending. Cuts in the Federal budget should be made with a long-term view of their competitive consequences.

The Commission recommended that the tax system be restructured to reduce the cost of capital so it could be put to work more efficiently and to stimulate productive investment. The bias against savings and investment should be reduced by placing greater reliance on taxation of consumption (with progressivity for fairness) and by eliminating double taxation on corporate profits. The variation of effective tax rates between different industries should be reduced, thereby supporting manufacturing industry in the tax rate. Disincentives to venture and other risk capital investments should be reduced by allowing individuals to claim fuller deductions for capital losses.

The Commission also recommended that stable monetary policy

be pursued to dampen the widely fluctuating interest rates and rates of inflation which have plagued American industry since 1970. Finally, reliance should be placed on the free market to determine capital flows. Regulation and resource allocation policies should minimize the types of Government intervention that presently hamper the free flow of capital to the most productive uses.

Human Resources

The Commission believed that action must be taken to develop a more skilled, flexible and motivated workforce. An essential part of such action should be steps to increase the effective dialogue between Government, industry, labor and academia. Existing federal advisory committees should have their charters and memberships reviewed for the purpose of enhancing their ability to deal with competitiveness issues. They would then have a better ability to achieve a consensus on facts and tradeoffs on policy options which would be available to the Government. A small staff should be created in the White House to study competitiveness issues, not limited to human resources, and provide advice to the President.

The Commission called for action, by labor and management, to improve cooperation, recognizing that it cannot be legislated by the Government. Management must be more open with relevant information and must be willing to share prosperity. Labor must be responsive to the goals of the firm and flexible in dealing with changing circumstances. Management should strengthen incentive programs by providing labor with the opportunity to share in success through programs such as stock purchase. The tax code should be amended to avoid immediate taxation of options and thus encourage long-term ownership, cementing the shared success relationship.

Focus must be given to our national ability to redeploy labor displaced by changing markets and technologies. Comprehensive services should be provided to workers such as job search, counseling, training and relocation assistance. The labor exchange functions of the U.S. Employment Service should be strengthened. The unemployment benefits program should be used to encourage employers to hire and train workers by creating a mechanism to allow workers to convert benefits to a wage subsidy voucher.

Employer investment in training should be encouraged through the tax code by a balanced treatment of physical and human capital investments. The ability of vocational and community colleges to deliver industrially relevant training should be strengthened by providing curriculum planning assistance through technical committees, such as those called for in the Vocational

Education Act. More of the vocational funds provided by the Federal Government to the states should be allocated to post-secondary students.

Steps to strengthen the ability of the universities to train engineers and scientists should include Government stipends for graduate study in engineering, focused on areas suffering faculty shortages; augmented funding for engineering research; and tax credits for industry funding of university research or donation of equipment.

The Commission also supported the reports of the National Commission on Excellence in Education and the Education Commission of the States which call for action to achieve excellence in elementary and secondary education. Federal funding should be provided for prototype research for the effective use of computers in education.

Trade Environment

Perhaps the most fundamental of the recommendations made by the President's Commission is the proposal to make trade a permanent national priority, an action which would cause many of the systemic competitive distortions to be dealt with. The first step would be to reorganize the Government to improve the policymaking process. To place trade considerations at the same level of importance as domestic and foreign policy issues, a Cabinet-level Department of Trade should be created. The goals of the department would be to enunciate trade policy, eliminate duplication and overlap and establish an effective coordination mechanism to balance trade with other policies.

A task force should be created, with representatives from Government, industry, labor and agriculture, to develop an omnibus trade bill which would correct the existing problems in trade law. Antitrust law must also be changed to recognize the potential efficiencies of mergers or other business combinations, particularly for embattled industries suffering from foreign competition. Uncertainty regarding antitrust violations can be softened by eliminating the award of treble damages except for behavior explicitly prohibited by law.

A balance must be achieved between competitiveness and national security and foreign policy considerations in the control of U.S. exports. American national security controls should be consistent with those of the 15 allied members of the Coordinating Committee for Multilateral Export Controls (COCOM). Foreign policy controls of exports should be imposed multilaterally, recognizing the validity of preexisting contracts and should not be applied to foreign affiliates of U.S. firms. In effect, U.S. firms should be allowed to play by the same rules as

those in other countries within the context of COCOM. If material can and will be exported by our allies, U.S. firms should be allowed to export as well. The process of obtaining the authority to export should be streamlined by one-step regulatory reviews, expanded delegation of authority to the Department of Commerce, electronic license application, common interagency data files, and multiple-shipment licensing. As noted earlier, positive steps to improve and expedite the licensing process have been announced by the Departments of Commerce and Defense, since the publication of the Commission's report.

U.S. exports should be promoted by strengthening the role of the Export-Import Bank in financing exports. The Department of Commerce should take the lead in an interagency effort to improve the collection and dissemination of foreign market information to potential exporters. Consideration should be given to creating a semiprivate U.S. export promotion organization similar to those of other trading nations.

Finally the Commission believed the U.S. should take action to strengthen the international trading system through future rounds of GATT negotiations. Priorities for discussion should include government practices affecting industry, import safeguards, countertrade and barter, commercial counterfeiting and intellectual property rights, direct foreign investment, performance requirements, international tax practices, trade in services, trade in agriculture, and the GATT dispute settlement process. It should be noted that several of these issues have been adopted by the U.S. for inclusion in the forthcoming GATT talks.

IV. SUMMARY AND CONCLUSIONS

This report provides the results of a survey of literature dealing with foreign dependency and is Phase I of a two-phased effort. Phase II will be completed in April 1987 and will address several issues derived from the Phase I effort. First, Phase II will define the circumstances in which the dependencies identified in Phase I represent vulnerabilities which must be eliminated. The various studies discussed in Phase I generally did not distinguish between dependence and vulnerability but implicitly assumed a total cutoff from foreign sources without an examination of the circumstances which might cause the cutoff. Second, through the medium of case studies, Phase II will develop the costs and benefits of alternative generic means of eliminating vulnerabilities.

A. SUMMARY

Surge/Mobilization - Significant foreign dependencies exist in major weapon systems; cutoff would mean serious disruption of production.

Problem

The conclusion that emerges from the defense studies is that significant foreign dependencies exist in major weapon systems. The indication is that the problem is widespread and probably exists in most defense systems. The range of dependencies includes total systems such as chemical suits; major sub-systems such as heads-up displays and ejection seats; electronic assemblies; and electronic components including semiconductors and ceramic packages. Other dependencies noted in the studies include optics, chemicals, and raw materials ranging from electronic feed materials to strategic and critical materials.

Three basic industries were addressed in reports requested by Congress. A report to the House Appropriations Committee on the semiconductor industry said fundamental concerns are raised by a structural manufacturing dependence upon foreign sources for materials, parts and production equipment. A report on the U.S. bearing industry found it to be in imminent danger of being unable to support national defense needs. Regarding the U.S. ferroalloy industry, a report concluded that if U.S. capacity were lost, mobilization requirements could be met only if U.S. demand had absolute priority on worldwide capacity and there were no disruptions or noncooperation.

In general, NATO and the European countries tend to be the sources of foreign dependency for complete systems or major subsystems, as well as for built-up components and chemical products. Japan and the Far East are the principal sources of semiconductors and semiconductor assembly essential to U.S. systems containing electronics.

Impact

For the Sparrow, M-1 tank, OH-58D helicopter, sonobuoys, F/A-18 and F-16, the impact of a total cutoff from foreign sources would be a drop to zero production for periods ranging from 6 to 14 months, starting as early as the second month after M Day. This was the finding of A Study of the Effect of Foreign Dependency prepared for the Joint Logistics Commanders.

Technology - Growing foreign dependency exists in the electronic technology base critical to advanced weapon systems.

Competitive forces in the world-wide semiconductor industry threaten U.S. technological leadership. The fundamental technological concern is the long-term health of the independent or "merchant" portion of the U.S. semiconductor industry. A healthy merchant semiconductor industry is said to be essential because militarily useful semiconductor technology (due to dual use) is increasingly being driven by commercial applications. The other portion of the U.S. semiconductor industry, the "captive" producers such as IBM and AT&T, notwithstanding their broad technological capability and current good health, cannot be expected to carry the entire load of maintaining U.S. technological leadership across the entire spectrum of militarily essential electronics technology.

The merchants' share of the domestic market has dropped from 58 percent in 1984 to 50 percent in 1985 and a projected 48 percent in 1986. The effect will be a growing inability to fund R&D and make capital investments at levels high enough to remain competitive. Therefore, within the next decade, the possibility exists that the U.S. may become dependent upon foreign sources for semiconductors. Semiconductors are the key building block for electronics which increasingly provide the qualitatively superior weapons needed to overcome the quantitative superiority of the Soviet Union.

The U.S. semiconductor equipment industry, which provides the machine tools of the electronics industry, is in a similar condition. Semiconductor technology of the future will involve small integrated circuits, more complex device architecture and innovative uses of new materials. According to a recent 1986 report published by the National Research Council, the future of electronic materials and devices critical to advanced defense systems depends entirely upon the development of advanced processing technologies. The report says the Japanese are currently ahead in 8 of 11 key areas of advanced processing technology.

The Defense Science Board and the National Security Council have been examining the U.S. semiconductor industry in terms of its impact upon national security, principally from the standpoint of technology.

Foreign dependency is not being addressed in any systematic or effective way, either by correction or accommodation.

Although the very existence of the studies represent

attention to the issue of foreign dependence as a potential first step to action, a persistent theme that emerges from the studies surveyed is that foreign dependencies in weapon systems have not been dealt with in any systematic or effective way by DoD. Little action beyond the studies has been taken to identify the existence of foreign dependencies in specific weapon systems and to pursue effective corrective actions which would result in the creative of alternative domestic sources. On the other hand, no broad-based action has been taken to assure that the U.S. can live with foreign dependencies in a national security emergency. At the present time, other than the long-standing industrial mobilization agreement with Canada, the U.S. has no cooperative industrial mobilization agreements with its friends and allies which would assure the continued supply of essential manufactured goods in the event of a crisis. In effect, the assumption that foreign sources will be available in a crisis is just that - an assumption.

An indication of the lack of a systematic treatment of foreign dependency is the conclusion reached by several studies that no data base or information management exists that contains good information on the incidence and extent of foreign dependence in specific weapon systems. Foreign dependencies were hard to find and much of the available information was misleading, obscure and hard to assess.

The imbedded nature of many of the dependencies, evidenced in the difficulty in identifying specific items within weapon systems, is a reflection of the dependencies that exist in the overall U.S. economy. At the sub-tier level, defense foreign dependencies are a microcosm of economic interdependence that has evolved over the years. The economic causes of dependencies include lower cost, higher quality and the distortions resulting from an overvalued dollar.

Beyond economic causes, the studies point to a second major cause of foreign dependencies, the policy conflict that exists among three conflicting DoD goals. The three goals are NATO rationalization, standardization and interoperability (RSI), protection of the U.S. mobilization base, and competition. RSI will facilitate resupply in a conflict and, among other things, calls for greater industrial cooperation with NATO as a means of strengthening the military capability of the alliance. Foreign participation is encouraged in sub-contracting to U.S. primes, in teaming and licensing arrangements, and in early industrial participation in R&D projects. NATO country contractors are also afforded the opportunity to compete for DoD procurement. The intent of increased cooperation is to strengthen the "NATO Industrial Base." The second goal, the "U.S. Mobilization Base", dates back to 1952 and calls for the maintenance of a sustained state of national mobilization production readiness. Specifically, the facilities, machine tools, production equipment, and

skilled workers necessary to produce wartime requirements are to be maintained for immediate use in an emergency. The third policy goal, competition, is founded in the Competition In Contracting Act. According to several studies, the priority given to competition is often not balanced by consideration of mobilization base issues. Competition goals could lead to awards to non-NATO foreign firms, thereby supporting neither RSI or the U.S. mobilization base.

The practical effect of the policy conflict is that program managers have no clear guidance on how to resolve the several priorities. As a result, procurement policies and practices do not adequately address foreign dependency. As an extension of this point, A Study of the Effect of Foreign Dependencies prepared for the Joint Logistics Commanders, observes that DoD is not managing foreign dependencies during system development and procurement. In addition, no effective organizational responsibility exists within DoD for addressing foreign dependency, according to the studies. However, in July 1986 and not addressed in the literature reviewed in this survey, the Army Materiel Command took action to create a Production Base Advocate whose task it will be to inject industrial base surge and mobilization issues into the Army's acquisition process.

It was noted that a lack of action by DoD to emphasize and deal with the issue will result in increasing foreign dependency in future weapon systems.

The defense industrial base is founded on the civilian industrial and technological base. The U.S. is losing both smokestack and high technology industrial capability. Currently healthy industries essential to national defense have the potential of losing competitiveness.

A healthy civilian industrial base is critical to the capability of the defense industrial base. That fact is rooted in the production relationship that exists between the two. Military and civilian demand are met by the same general industries which draw from the same basic production input factors such as capital, technology, scientific and skilled manpower, and management. Therefore, weapons production rests on the same foundations as the national ability to produce industrial and consumer goods. Weaknesses and gaps which exist in subtier and basic industries will inevitably affect the national ability to produce weapon systems critical to national defense.

Many studies are available which address the health and international competitiveness of U.S. industry, few of them in a favorable light. The preeminent document is the report of President's Commission on Industrial Competitiveness, Global Competition - The New Reality. The report makes the point that

the economic environment in which U.S. industry operates has changed dramatically since the 1950's. The U.S. economy has been overshadowed by the growing international economy which is becoming increasingly interdependent. Almost 20 percent of U.S. production is exported and over 20 percent of U.S. goods must compete with foreign products in the domestic market. There has been a shift away from Europe as the major trading partner. The new competitors for U.S. industry are Japan and the newly industrialized countries of the Pacific Rim - Taiwan, South Korea, Singapore, Hong Kong and Malaysia. These countries have taken advantage of the mobility of technology and have aggressively applied it to the manufacture of high quality, low price consumer goods.

At the same time that major new and highly productive competitors have emerged, the U.S. has experienced a stagnated productivity growth rate. From 1960 to 1983, the U.S. has had an average annual productivity growth rate of only 1.2 percent, lower than all of our major trading partners. In contrast, Japan had 5.9 percent annual growth, Korea had 5.3 percent and West Germany 3.4 percent.

Productivity has been one factor in a growing problem of negative trade balances. The U.S. has had a negative trade balance since 1975, as contrasted to a positive trade balance for the entire 20th century prior to 1971. As of July, the U.S. was on a track towards a negative balance of $170 billion for 1986. The U.S. has lost world market share in both smokestack and high technology industry. Global Competition notes that, since 1965, 7 of 10 high technology industries have lost market share. The effect of the decline is diminished production and technological capability in industries critical to national security. Each of the industries discussed in the report is important to national defense, either as a direct producer of military goods or as convertible capacity in a mobilization.

In contrast to our trading partners, most of whom set trade and industrial competitiveness as national policy, the U.S. has no national policy pushing trade. Given the international environment in which the U.S. must now compete and the fact that a positive trade policy would be the starting point for many other policies, the lack of a national policy is an important cause of U.S. industry competitive decline. Examples of policies that are inadequate to the new reality of global competition are trade and antitrust laws, which are obsolete in both form and effectiveness.

Besides trade policy, fundamental problems exist in the areas of technology, capital, human resources and, until very recently, the exchange rate of the dollar. Notwithstanding large national R&D expenditures, the U.S. lags in developing and applying technology to new products, particularly in relation to

Japan. Government funded R&D has no competitiveness goal and no common management. Few incentives exist for privately funded R&D in basic research, which is the first step in developing new technology. The U.S. trains fewer engineers than Japan and 55 percent of U.S. engineering doctorates awarded in 1984 went to foreign citizens. This has implications for our ability to train more engineers in the future.

The supply of capital to U.S. industry is inadequate, according to the President's Commission. The first cause is the low U.S. savings rate. It is much lower than that of our foreign competitors, particularly Japan which saves at a rate of about 18 percent vs a U.S. savings rate of about 7 percent. The second cause is the U.S. budget deficit. Since the Government has first call on capital, it bids it away from private industry. The influx of foreign capital has mitigated this circumstance, but cannot be counted upon indefinitely.

The quality of the U.S. human resource base is deteriorating for a variety of reasons. One cause is the historic adversarial relationship between management and labor which may no longer serve the interests of the parties involved or the nation as a whole. Another is the lack of adequate programs to develop new skills in displaced workers, who should be redeployed to new jobs deriving from new technology and markets. Part of the redeployment issue is the need for forward-looking training, from employers and from the educational system. The President's Commission notes that employers have few incentives to train their workforce beyond the requirements of the current job. It also endorsed the call for improvement in elementary and secondary education made by other bodies.

U.S. industry is reacting to the various circumstances just described by focusing on survival, regardless of what it takes. BusinessWeek has coined the phrase "Hollow Corporation." To survive, U.S. companies are outsourcing parts and materials, outsourcing labor to perform the assembly operation and outsourcing product lines. In the latter case, such as small cars, machine tools and construction equipment, U.S. companies have withdrawn from the manufacture of certain types of product and have maintained market segment by putting their label on foreign produced goods. The effect of this is to lower demand for other U.S. industries such as steel, forgings, castings and a host of other basic industries.

Another strategy being pursued by industry is an increasing movement to joint R&D and manufacturing ventures with foreign firms, which have the potential effect of creating more interdependence, more foreign competition, and less domestic capability, particularly in the basic industries.

B. CONCLUSIONS

Like the U.S. economy as a whole, the U.S. defense industries directly or indirectly purchase some portion of their goods from abroad. Left unaddressed, this could affect national security. If there are risks posed to national security by foreign dependency, DoD needs to pursue two basic courses of action.

First, as regards its own plans and programs, DoD needs to manage foreign dependency in a focused, effective way. It needs to resolve the conflict that currently exists by balancing the policy goals of RSI, maintenance of the mobilization base, and competition. A policy should be set which requires that foreign dependency be managed during system development, as well as in early research and development for future systems. DoD needs to set responsibilities within the organizational structure, to assure that the problem is dealt with on an equal footing with other acquisition issues. Once policy and responsibilities are set, comprehensive programs to enforce compliance must be put in place.

Second, beyond DoD's specific responsibilities in acquiring and fielding weapons, DoD should take an active leadership role within the Federal Government to assure that the national security implications of the deteriorating U.S. industrial and technological base are addressed in national policies and programs.

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